Blood Pressure in Human Interaction

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Een wetenschappelijke proeve op het
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in het bijzonder de psychologie

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Voorwoord

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Brigit van Widenfelt corrigeerde meer dan zorgvuldig de teksten op Engels taalgebruik. Haar stijlaanwijzingen hebben bovendien de teksten belangrijk verbeterd.

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Introduction

Hypertension, the state of chronically raised blood pressure (BP), is a risk factor for coronary heart and cerebrovascular disease. In Western societies it is a common condition with a high prevalence. In a large survey study of 16,000 Canadians, 11 % of adult men and 6 % of adult women were classified as hypertensive according to the criteria of the World Health Organization (Stephens, Craig, & Ferris, 1986). In over 90 % of hypertensive subjects no physical cause can be accounted for, resulting in the diagnosis primary or essential hypertension. In only a few cases, 5 to 10 %, a diagnosis of secondary hypertension is given, where a physical cause can be established.

Epidemiological research suggests that genetic predisposition, salt intake, and obesity play a role in the etiology of essential hypertension and that socioeconomic status and race are important risk factors (James, 1987). These variables do, however, not provide sufficient information in explaining the occurrence of hypertension among individuals. Therefore, social scientists have given additional attention to predisposing behavior patterns, hyperreactivity of the sympathetic nervous system, and stressful life events relevant in the development and prediction of essential hypertension (Heine & Weiss, 1987). In regard to the treatment of hypertension, medication is most commonly used and most often effective, but given negative side effects of the medication, the development of adjunctive or alternative behavioral treatment strategies is required (Stainbrook, Hoffman, & Benson, 1983).

One psychosocial variable that is of particular interest in explaining high BP responses is interpersonal interaction. Social interactions have been reported to cause an increase in BP of up to 50 % above baseline (Wolf, Cardon, Shepard, & Wolff, 1955). The factors in interpersonal behavior that cause BP increases have, however, been insufficiently specified (Ewart, Burnett, & Taylor, 1983).

In order to capture certain elements of an interaction Singer and her colleagues introduced the concept of involvement and found that the degree of involvement during social interaction plays an important role in determining BP levels (Hardyck, Singer, & Harris, 1962). Over the course of time a distinction has been made between transactional involvement, self-involvement and topic-involvement. Transactional involvement refers to, "that central phenomenon which suggests a person is locking into, actually investing in an interaction, in its internal and external aspects. It includes features of attention, alerting, arousal, affect, activation, but refers to more than each of these" (Singer, 1974, p. 2). To measure transactional involvement, Scherwitz, Berton, and Leventhal (1978) used the frequency of the personal pronouns, "I", "me", "my", and "mine". This self-reference count was later referred to as self-involvement because it reflects a self-focus. Self-involvement measured this way during a standardized interview was found to be correlated with extent of cardiovascular disease (Scherwitz et al., 1983). Topic-involvement, referring to the personal relevance of a topic was introduced as another key construct, placing a separate emphasis on involvement with the content of an interview. Content has been reported to have a facilitating or hindering role in determining transactional involvement (Williams, Kimball, & Williard, 1972). The literature suggests that hypertensives show generally little involvement in interactions and little variation in the quality or extent of their involvement (Singer, 1974; Linden, 1983).

In sum, it can be concluded that the psychosocial determinants of BP increases may be highly individual-specific. Reis and Ledoux (1987, p. I-7) summarize this position in the statement, "Perhaps the greatest elevations in blood pressure will occur in response to conditioned emotional responses generated by internal feeling states in response to interpreting the symbolic value of environmental stimulus." In order to include individual aspects in our study, some of the experiments will comprise the subject's valuation of an element of the interaction.

Research purpose

The present study examines behavior in relation to cardiovascular reactivity. As the repetitive and summated occurrence of heightened BP responses is hypothesized to play a role in the development of hypertension (Manuck & Krantz, 1986), the identification of variables that cause high BP responses is clearly of great importance. A first step is, however, the identification of variables that coincide with high BP responses.

This study attempts to identify variables in verbal interaction that determine BP levels in normotensives and hypertensives and more specifically which of these variables influence BP differently in normotensives than in hypertensives. We limited the experiments to variables that play a role during verbal interaction.

Overview

In a review of the literature in Chapter 2 studies in which BP during verbal interaction was assessed are summarized. A classification of the studies by independent variables resulted in four categories. The first, consisting of content, topic-involvement, and emotions, demonstrates an emphasis on the emotions anger and anxiety. A second category represents a transactional view and contains interpersonal variables, especially transactional involvement. A third category comprises speech-related variables such as rate and volume of speech, and the fourth category consists of individual difference variables with an emphasis on self-involvement and Type A/B behavior pattern. Most of the studies were limited by the use of devices that could only measure BP at intervals of 1 minute or more. Recently, a new device was developed that measures BP noninvasively and continuously with a small finger-cuff. This device, the Finapres, makes a precise monitoring of BP during human interaction possible (Settels & Wesseling, 1985).

The first of a series of experiments began with a traditional device that we used previously in experiments on BP during noninteractional tasks (van Schijndel, De Mey, & Näring, 1984, 1985). In this first study we replicated an experiment by Ewart, Burnett, and Taylor (1983) in which the influence of distinct categories of interpersonal variables on BP appeared to be established. Ewart and his colleagues manipulated the interaction of two couples in an A-B-A-B design by means of a communication training program and concluded that the BP of the hypertensive husbands covaried positively with the amount of disruptive communication of the spouses. Our aim was to replicate these findings while controlling for other variables that may also influence BP during an interaction. In our replication of this experiment with one couple we also paid attention to speech duration, nonverbal behavior (Marital Interaction Coding System; MICS; Weiss & Summer, 1983), and self-involvement of the husband (Scherwitz, Berton, & Leventhal, 1978). As in the original report, BP was measured at intervals of 2 minutes with a Dinamap. This replication study is described in Chapter 3.

In the following experiments, continuous BP data became available with the use of the Finapres. We developed a system to synchronize a videorecording of an interaction with BP measurements in order to match BP data to videodata. A description of this system in Chapter 4 precedes these experiments.

The second experiment examined the influence of speech on BP. It is well documented that speech causes a large increase in BP (Lynch et al., 1980). Furthermore it is often assumed that hypertensives show a higher BP response to speech than normotensives. If a higher BP response to speech in hypertensives exists, speech characteristics and respiration activity may be relevant factors in the etiology of hypertension (Friedmann, Thomas, Kulick-Ciuffo, Lynch, & Suginohara, 1982). If a higher response to speech is only evident during actual interaction, then engagement or interpersonal stress may be of relevance. A critical review of these studies indicates that the evidence for a difference in BP response to speech between normotensives and hypertensives is weak. Few of the studies that we reviewed included both a normotensive and a hypertensive sample and many studies described mixed groups of hypertensives with and without anti-hypertensive medication. We actually found only one report of a statistically significant difference in BP response to speech between normotensives and hypertensives (McKegney & Williams, 1967). In our second experiment, described in Chapter 5, we addressed this issue by asking normotensives, hypertensives with medication, and hypertensives without medication to (A) relax, (B) read subvocally and (C) read aloud for 1-min periods in an A-B-C-B-C-A design. In this experiment a difference between normotensives and hypertensives in BP response to speech per se was assessed.

The role of involvement with the topic of a conversation in determining BP level is explored in the third experiment. The level of involvement with a topic is thought to interact with transactional involvement. Since the impact of a topic on a person is highly individually determined, the choice for a self-report measure of topic-involvement is indicated. The Self-Confrontation Method by Hermans (1987) offers a frame to guide a personal discussion as well as a method to assess the individual affective aspects of the topics discussed with measures of general, positive, and negative involvement. In Chapter 6 we describe the use of this method to investigate the relation between measures of topic-involvement and BP measured during a discussion in normotensives and hypertensives.

In the last experiment a treatment program is evaluated. Behavioral treatment of essential hypertension consists mostly of relaxation or biofeedback procedures (Wadden, Luborsky, Greer, & Crits-Christoph, 1984). These treatments are non-specific and may be made more effective with knowledge of specific behaviors that cause BP rises. The design of a program to alter interactional behavior that is associated with BP increases is described in Chapter 7. In this program hypertensive subjects are taught to change interactional behaviors with standard elements and individually assessed elements. In order to evaluate the effect of this program on BP, an intervention that is usually effective in lowering BP, biofeedback assisted relaxation, is used as a control program.

In Chapter 8 the results of this series of experiments are summarized. The findings are discussed together with recent findings from other research reports. Attention is also given to some methodological issues.

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Blood Pressure Response During Verbal Interaction: Review and Prospect.[#]

Gérard Näring, Hubert De Mey, and Cas Schaap

Blood pressure changes during verbal interaction have typically been measured by noninvasive devices, at regular intervals of 1 to 5 minutes, in hypertensive as well as in normotensive subjects. In the earlier studies the role of content variables has been emphasized together with that of the emotions of anger and anxiety. Later, transactional involvement has been focused upon as one of the main causes of blood pressure changes. Two categories of independent variables that have received recent attention are the act of speaking itself and individual difference variables such as the Type A behavior pattern, which is characterized by a competitive, aggressive and impatient style of living. The discontinuous and momentary nature of most measurement techniques poses serious limitations to the study of fast fluctuating physiological changes during verbal episodes. In this regard, the recent advent of a noninvasive device for the continuous measurement of blood pressure could give a new impetus to the experimental clinical investigation of blood pressure changes during verbal communication.

Changes in blood pressure appear to be caused by a multiplicity of factors, including a person's genetic and behavioral history as well as the current environmental and social contingencies he or she is confronted with. Interorganismic interactions have been considered as important in determining blood pressure response in animals (Henry & Stephens, 1977) as well as in humans (Lynch, Thomas, Paskewitz, Malinow, & Long, 1982). One particular kind, namely verbal interaction, has been chosen as the topic of this review as it represents an integral part of our daily emotional transactions with others.

Blood pressure response during verbal interaction has been studied in order to detect which variables produce blood pressure changes, as well as to what extent and in which type of individuals they occur. The rationale underlying this type of study is primarily derived from the hypothesis that repeated and prolonged blood pressure fluctuations might — at least in predisposed individuals — contribute to the etiology of essential hypertension (Groen, van der Valk, Welner, & Ben-Ishay, 1971; Julius, Weder, & Hinderliter, 1986) and to the pathogenesis of coronary heart disease (Eliot & Buell, 1983; Manuck & Krantz, 1986).

We have selected those studies that contain a description and/or measurement of at least one of the various aspects of verbal interaction in sufficient detail so as to allow the detection of correlation or causation with respect to corresponding changes in blood pressure. Furthermore, blood pressure responses had to be measured repeatedly, continuously, or at least before and after the interaction episode.

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We begin with a review of the relevant articles and conclude with an indication of new directions for research made available by recent technological advances in the measurement of blood pressure

Types of verbal interaction situations

Verbal dyadic interaction typically comprises the behavior of two people communicating with each other, alternating speaker and listener roles. The interactions encountered in the studies to be described may vary, however, as to the amount of "interacting" actually occurring.

The main type of verbal interaction encountered in the articles is some form of interview or conversation. Examples are the Type A/B Structured Interview, in which blood pressure response and elements of the interaction were measured on the assumption that hemodynamic reactivity is linked to clinical manifestations of coronary heart disease (e.g., Krantz et al., 1981); the patient-doctor interview, in which biographical or anamnestic data are being collected (e g , Innes, Millar, & Valentine, 1959); psychotherapeutic interactions, mostly of a psychodynamic nature (e g., Alexander, 1939); the mental stress interview, in which a topic known to be disturbing to the subject is introduced to elicit bodily changes (e.g., Wolf, Cardon, Shepard, & Wolff, 1955); and problem-solving discussions about real or simulated problems (e g., Ewart, Burnett, & Taylor, 1983). In other situations, subjects were asked to talk about a dramatic or personal life experience (e.g., Kaplan, Gottschalk, Magliocco, Rohovit, & Ross, 1961), to read from a book (e.g., Lynch et al., 1980), or to tell a story before a jury (Marston, 1917), all with minimal interruption by the listener. Finally, in some situations the person was simply required to react verbally to standardized stimuli such as a quiz (e g., Dembroski, MacDougall, & Lushene, 1979) or a structured projective test situation (e.g., Weiner, Singer, & Reiser, 1962).

Classification of studies according to independent variables

Content and emotion

Alexander (1939), in an indepth interview with a hypertensive patient, found a "clear correlation between emotional disturbances and change of blood pressure" (p. 150). He specified the emotional state as containing evidence of inhibited hostile aggressive impulses, but also mentioned anxiety and depression Palmer (1950) detected the highest blood pressure reactions while questioning hypertensive patients about their high blood pressure. Hambling (1952) concluded from his study that pressor topics in hypertensive patients had to do with hostile feelings which the patient could not express. Moses, Daniels, and Nickerson (1956) emphasized the emotions of rage, hostility, and anxiety, and the role of overt expression of the latter in determining the pattern of cardiovascular reactions in hypertensives during intensive therapeutic psychoanalysis. Van der Valk (1957), looking at the emotional effects of certain interview topics, noticed a difference in the pattern of response between fear and anxiety on the one hand and hostility and anger on the other hand. The first two emotions were associated with a relatively greater diastolic blood pressure (DBP) than systolic blood pressure (SBP) response, while the latter two emotions showed the opposite pattern in both normotensives and hypertensives. In comparing essential hypertensives as a group with other groups, including a control group, Innes et al. (1959) did not find any systematic differences among the groups with respect to the emotional content of specific topics brought up during a biographical interview. All of these topics raised blood pressure, but in an idiosyncratic way. In contrast to this study, Kaplan et al. (1961) found more hostility in the verbal productions of a group of 10 essential hypertensive patients than in a group of 10 normotensives. In addition, they found a correlation between amount of hostility and level of blood pressure in two case studies conducted with hypertensive patients. In a series of interviews with an essential hypertensive patient, Treurniet and Wilde (1966) could reliably predict blood pressure changes on the basis of interview content categories derived from the psychosomatic specificity-hypothesis of Bastiaans (1957), which emphasizes inhibited aggression. Adler et al. (1974, 1975, 1977) compared the content of interview sequences preceding maximal increases in blood pressure with those preceding maximal decreases. With this "symptom context-method" they discovered a relationship between content and blood pressure for three out of nine content categories. The essence of these three categories was summarized as "active control over yourself and your environment." A lack of control was associated with higher blood pressure levels.

Groen et al. (1982) showed that hypertensives had the same hemodynamic reaction pattern as normotensives during an interview about personal life situations. This pattern, referred to as "hypertonic", consisted of a minor increase in heart rate, cardiac output and peripheral resistance. During physical exercise a different "hyperkinetic" pattern was observed, which was characterized by a larger increase in heart rate and cardiac output, and a decrease in peripheral resistance. An analysis of the mechanisms of blood pressure changes during verbal interaction undertaken by Svensson and Theorell (1982) revealed results similar to those of Groen and his associates. Finally, Reindell (1985) found different hemodynamic reaction patterns associated with the different ways in which anxiety and anger were expressed during a psychoanalytic session with two groups of patients, one group suffering from colitis, the other from cardiac neurosis. Patients in the latter group appeared to verbally express their aggression more than the former and showed the lower increase in heart rate.

In conclusion, the above studies indicate anger and anxiety as the prevailing emotions during verbal interaction. A possible differential effect of each of these emotions upon systolic and diastolic blood pressure has been suggested. Attention has also been paid to the effect of inhibiting (controlling) versus expressing emotions on the increase or decrease of blood pressure. In most of these studies, emotions have been related to the content of the verbal material, which usually centered around personal conflicts in the subject's or patient's life.

Interpersonal variables

Several studies have attenuated the emphasis placed upon topic or content in determining blood pressure response during verbal interactions. Reiser, Reeves, and Armington (1955) manipulated status (military rank) and reassurance (amount of uncertainty) in soldiers who were called to volunteer for experimental purposes. Interestingly, they attributed the effects on blood pressure to the actual relationship taking place between subject and experimenter, thus emphasizing transactional involvement, which was assumed as being capable of altering the total meaning of the experimental situation. For example, when the person was allowed the free expression of critical attitudes toward the military system, his blood pressure decreased, irrespective of differences in the rank of the experimenter.

Also in an interpersonal context, Reiser, Weiner, and Thaler (1957) advanced the hypothesis that hypertensives would hold their vascular reactivity in check through the psychological mechanism of setting up an "insulated" (detached) object relationship with the examiner. They found hypertensives to be "hyporeactive" when compared to a group of normotensives in similar interview situations. With the development of a close relationship to the examiner, a blood pressure hyperreaction was observed. Weiner, Singer, and Reiser (1962) similarly found that essential hypertensives, while recounting a story of the Thematic Apperception Test (TAT), appeared to be hyporeactive as compared with normotensives. They seemed to talk without emotion, to behave distantly and to remain uninvolved and "insulated." When the interaction became "closer," however, they became hyperreactive. The authors concluded that involvement with another person was more important than involvement with content of the TAT story.

Hardyck, Singer, and Harris (1962) found that amounts of "alerting" or "involvement" were better predictors of blood pressure elevations than specific affects or contents. They, too, favored a transactional view above an intrapersonal one. In the same spirit, Williams and McKegney (1965) and Williams, Kimball, and Willard (1972) interpreted their results in terms of the role of an emotionally meaningful interaction.

The effect of status or social distance between subject and experimenter during the course of an interview has also been investigated by Long, Lynch, Machiran, Thomas, and Malinow (1982). They found a significant main effect for status, and a significant interaction effect between status and verbal activity. Blood pressure increased more during speaking than during silence, when social distance was greater.

Baer, Vincent, Williams, Bourianoff, & Bartlett (1980) reported a correlation between the frequency of negative nonverbal behavior (e.g., not responding, grimace, gaze aversion) exhibited by hypertensive fathers and the level of systolic blood pressure of their children. Hence style of communicating might be more important than content, also in its effect upon the blood pressure of the other person (i.e., the listener).

In two studies (Ewart et al., 1983; Ewart, Taylor, Kraemer, & Agras, 1984) the authors concluded that increments in blood pressure reactivity were positively related to the frequency of disruptive or negative behaviors during communicative problem-solving. They further interpreted their results in terms of hostility, not as a topic variable present in verbal content material, but as a hostile (behavioral) way of communicating with others.

One final study deserves mention. In 1917, Marston conducted an experiment in which normotensive subjects could choose to tell the truth or to lie before a judge and a jury. The experiment was set up as an examination by a prosecuting attorney, with the subjects able to save a friend who was accused of a crime. The aim of the experiment was to investigate changes in SBP resulting from an effort to hide the truth. "Deceptive consciousness" turned out to heighten SBP: the average rise was 16 mm Hg during 56 deceptions taken from 10 different subjects. There is an interesting contrast here — as to the effect on blood pressure — between these attempts at deception and the defensive manoeuvres of hypertensives mentioned in the study of Reiser et al. (1957). In the latter, the "insulating" manner of relating to others, albeit unconsciously, appeared to be successful in lowering blood pressure response, whereas the subjects' conscious attempts at deception in Marston's experiment failed to do so. In the case of deception, emotions appeared not to be suppressed: introspection by the subjects showed that the characteristic emotions were those of fear (always) and anger (when in immediate danger of detection).

To summarize, these studies have focused attention on the transactional nature of conversations, which may influence blood pressure changes irrespective of what is being said. The key concept seems to be involvement (Singer, 1974), two types of which can be distinguished: involvement with content, as mentioned in the previous paragraph, versus interpersonal or transactional involvement. These two are not independent from each other. The role of content might be considered to be one of facilitating or hindering the kind of transactional involvement actually occurring. It is further argued that essential hypertensives are likely to show less interpersonal involvement than normotensives. This might appear in different forms such as an "insulating manner of relating to others," emotional denial, difficulties in self-disclosure or lack of social competence (e.g., Handkins & Munz, 1978; Linden, 1983). These have been viewed as strategies with which hypertensives attempt to keep their blood pressure in check during interactions with others.

Speech-related variables

Adler et al. (1974) reported that the number of words in 1-min intervals preceding the highest rises in blood pressure was greater than the number of words in comparable interview sequences taking place before the greatest decreases. Similarly, Silverberg and Rosenfeld (1980) found an increase of ca. 12% in blood pressure when comparing a period of silence in 24 hypertensives with a subsequent period of quiet conversation. Although this high pressure level was maintained during the conversation, it quickly returned to its original level thereafter. This confirmed the results of a previous study (Ulrych, 1969), which focused on the cardiac mechanisms — an increase of both heart rate and stroke volume — involved during conversation. Lynch et al. (1980) convincingly demonstrated the effect of a formal characteristic of verbal interaction, namely the act of vocalization on the blood pressure of normotensives, independent of content. Hellmann and Grimm (1984) reported a mean increase of 8 mm Hg in diastolic blood pressure during talking versus no-talking, and spelled out the implications for nursing and diagnostic practices. Other formal characteristics, such as rate and volume of speech, appeared to be related to increases in blood pressure of normotensives (Friedmann, Thomas, Kulick-Ciuffo, Lynch, & Suginohara, 1982). By comparing reading aloud with silent reading they controlled for cognitive activity, and thus demonstrated that the physical aspects of the act of speaking (in addition to affect) were primarily responsible for the blood pressure increases. In this context, they referred to the Type A behavior pattern, which is characterized by, among other things, high volume and high speed of talking. This brings us to the last category, indicated as "individual difference" variables.

Individual difference variables

Individuals may differ in some relatively stable psychological or biological characteristics such as personality, Type A/B behavior pattern, defensiveness, vascular and cardiac reactivity, parental or genetic history, blood pressure base levels, or hypertensive state. These factors are relevant to blood pressure changes during verbal interaction insofar as they interact with some of the previously mentioned situational variables. For example, Theorell, de Faire, and Fagrell (1978), and Theorell, de Faire, Schalling, Adamson, and Askevold (1979) demonstrated a likely genetic influence upon blood pressure level (systolic and diastolic) during and after a stressful interview in a study employing twins. McKegney and Williams (1967) observed that blood pressure increases during a personal discussion were greater in hypertensives than in normotensives. In hypertensives (Lynch, Long, Thomas, Malinov, & Katcher, 1981) as well as in normotensives (Friedmann et al., 1982), it has been shown that the higher the pressures during rest, the greater the blood pressure increases during talking, which clearly deviates from the law of initial values, which states that "the higher the prestimulus level of functioning, the smaller the response to a function-increasing stimulus" (Sternbach, 1966, p. 44).

Scherwitz, Berton, and Leventhal (1978) found that a more self-involved and pressured style of speaking was related to higher levels of blood pressure only in Type A individuals, who referred to themselves twice as often as Type B's during the Structured Interview. According to Jenkins (1971), Type A behavior is characterized by "extremes of competitiveness, striving for achievement, aggressiveness (sometimes stringently repressed), haste, impatience, restlessness, hyperalertness, explosiveness of speech, tenseness of facial musculature, and feelings of being under the pressure of time and under the challenge of responsibility" (p. 309). In Type B, these characteristics are relatively absent. Dembroski et al. (1979) discovered that Type A individuals also showed greater physiological arousal than their Type B counterparts, while exhibiting the very behaviors that are used to designate them as Type A's during the Structured Interview (viz., vigorous voice stylistics, competitive hostility and impatience). Also using the Type A/B interview, others found greater SBP increases in Type A's than in Type B's among patients with coronary heart disease (Krantz et al., 1981, 1982). Greater cardiovascular reactivity in Type A's during the structured interview was also found by Smith, Houston, and Zurawski (1985) and Blumenthal, Lane, and Williams (1985).

In summary, the bulk of studies concerning individual difference variables during verbal interaction has concentrated on the role of cardiovascular responsiveness of Type A's as compared to that of Type B's, in an attempt to unravel the physiological mechanisms mediating behavior or emotional stress and the occurrence of coronary heart disease. In general, the more challenging the interaction (cf. quiz vs. story telling) the greater the reactivity differences found between both types (Sime, Buell, & Eliot, 1980).

Formal characteristics of the studies

Subjects and designs

Most of the subjects in these studies had normal blood pressure levels. Approximately one third of the subjects may be classified as essential hypertensives.

With regard to research designs the studies could be divided into four categories (Paul, 1969). The first category consisted of *case studies*. Half of these studies, mostly of a psychoanalytic nature, were merely descriptive and did not use significance testing (e.g., Alexander, 1939; van der Valk, 1957). The other half, of more recent origin, used significance tests. Some of the latter were N=1 studies (e.g., Ewart et al., 1983; Adler et al., 1977). A second category, *non-factorial single-group designs*, used standardized pre-post assessments or alternating treatment and non-treatment periods (e.g., Silverberg & Rosenfeld, 1980; Lynch et al., 1981). A third category was that of *non-factorial groups designs*, as exemplified in Reiser et al. (1955) and Innes et al. (1959). *Factorial groups designs* were applied in more recent studies (e.g., Lynch et al., 1980; Ewart et al., 1984). Each of these four categories comprised about the same number of studies.

The measurement of verbal interaction

Verbal interaction variables have been measured with varying degrees of precision and objectivity. Clinical intuition was the preferred analytical tool in the earlier psychoanalytic studies. No clue was given as to how the verbal material had been coded (e.g., Alexander, 1939; Palmer, 1950). Objective scoring methods that have been used are diverse in nature: Ratings by independent observers (e.g., Dembroski et al., 1979), Thematic Apperception Test standard content analysis (Weiner et al., 1962), Gottschalk-Gleser Verbal Content Analysis (e.g., Reindell, 1985), the Symptom-Context method (Adler et al., 1975), the Marital Interaction Coding System (Ewart et al., 1983), and the Type A/B Structured Interview (e.g., Krantz et al., 1981). Subjective scorings by the subject/patient in the form of self-administered questionnaires or rating scales, if used at all (e.g., Scherwitz et al., 1978), have not been correlated with blood pressure changes.

In conclusion, content analysis and the rating of emotions and behaviors by others have been the main methods used to code the interaction. Scorings by the subjects themselves, especially impact ratings, have been conspicuously absent, although they could well be valuable (Gottman & Levenson, 1985).

The measurement of blood pressure and related variables

Dependent variables. In most studies, results of systolic blood pressure as well as diastolic blood pressure have been reported. Mean arterial pressure, which is held to be hemodynamically more important than peak values, has been electronically measured and reported primarily in studies conducted as of 1980 (e.g., Lynch et al., 1981). Most studies also reported heart rate. Other measures occasionally taken were Finger Pulse Volume (Innes et al., 1959), Heart Rate Variability (Dembroski et al., 1979), Rate-Pressure Product (Krantz et al., 1981), and Stroke Volume, Cardiac Output, Maximum Cardiac Force and Peripheral Resistance, often measured in ballistocardiographic studies (e.g., Reiser et al., 1955). Pulse pressure was mentioned once (van der Valk, 1957).

Spacing of measurements. In most of the studies, blood pressure was recorded at 1- to 5-min interval periods during the verbal interaction episode. In a few studies, only pre-post measurements were taken, with experimental periods in between ranging from 5 to 60 min in length (e.g., Baer et al., 1980). Continuous measurement of blood pressure was accomplished in only two studies (Adler et al., 1974; Treurniet & Wilde, 1966).

Equipment and type of measurement. Earlier studies made use of the standard sphygmomanometer procedure (manometer, Riva-Rocci occluding cuff, and stethoscope) to measure SBP and DBP. This method demands silence during the measurement period itself, and therefore was mostly used in pre- and post-measurements. The advent of "blood pressure machines" was a major breakthrough in the experimental study of blood pressure response during verbal interaction. The stethoscope was being replaced by a microphone built into the cuff or by a built-in transducer to detect arterial wall oscillations. This meant that the pumping of the cuff was now initiated automatically and graphical recordings of the results were substituted for unreliable eye-reading. In two studies (Adler et al., 1974; Treurniet & Wilde, 1966) an invasive procedure was used, with a microcatheter mounted in the brachial artery.

Limitations and new opportunities

In the studies above, a variety of factors accounting for blood pressure fluctuations during verbal interaction has been considered; emotional-cognitive, social-interpersonal, and biological-mechanical, as well as situational and individual difference variables. Different kinds of interactions have been investigated, and various designs and methods of analysis have been employed.

One of the main limitations of these studies seem to reside in the method of blood pressure measurement. Blood pressure changes have been measured at discrete time points with intervals ranging from 1 min to 60 min. Actually, blood pressure varies from heartbeat to heartbeat. In one person it may change from minimum to maximum within a period of 5 seconds and accomplish a full cycle within 10 seconds (Wesseling, personal communication). Since the optimal grain of analysis depends on the aim of the investigation, no "ideal" time unit can be proposed. Nevertheless, for the studies above, it might be argued that a more microscopic analysis at the level of seconds instead of minutes is to be preferred. In typical psychophysiological tasks, a person interacts with a relatively stable environment (e.g., when solving anagrams) so that blood pressure gradually builds up and slowly declines (van Schijndel, De Mey, & Näring, 1984, 1985). Contrary to this, there is no such constant environment in verbal interaction situations, where a close interplay is going on between two persons, thus causing blood pressure to change much more rapidly. In such situations, smaller units are required for analysis at the physiological level in order to be able to correlate them to corresponding events at the level of verbal interaction.

Until now, this kind of molecular analysis has virtually been impossible to carry out in psychological laboratories. Continuous intra-arterial measurement of blood pressure has been reserved for medical settings, especially operating rooms and intensive care units. Recently, however, a new instrument has been developed which also allows psychologists to measure blood pressure continuously and noninvasively. One such instrument, called Fin.a.press, has been developed by TNO (Utrecht, The

Netherlands) and Ohio Medical products (Madison, Wisconsin, USA). It operates on the principle of the unloaded vascular wall first described by Peñáz (1973), and has been found to closely follow intra-arterial readings taken simultaneously (Van Egmond, Hasenbos, & Crul, 1985). Using a fingercuff rather than an upper arm cuff has the additional advantage of causing less inconvenience to the client or patient. Further information about the instrument, such as operating instructions and performance, has recently been published (Settels & Wesseling, 1985; Wesseling, Settels, & De Wit, 1986), and confirms the reliability and validity of this measurement instrument.

Once the technological problem of continuous measurement is solved, a psychological problem remains in the discovery, conceptualization, and operationalization of the variables that are functionally related to changes in blood pressure. Furthermore, correspondence should be sought between the grain of analysis at the level of interaction coding and that of blood pressure measurement. As for the former issue, several coding systems deserve attention. The Marital Interaction Coding System (Weiss & Summer, 1983), for example, has been used in two experiments with hypertensive men and their wives (Ewart et al., 1983, Ewart et al., 1984). The Verbal Response Mode coding system (VRM, Stiles, 1978) categorizes phrases according to three aspects: frame of reference, source of experience and focus of the speaker. Form and intent are separately coded and reflect themselves in doublecodes. A disadvantage, however, is that non-verbal behavior is omitted from coding. Neverthcless, gaze and gaze aversion appear to be important variables in determining blood pressure during dyadic and family interactions (Baer et al., 1983).

Both verbal and nonverbal behavior are coded in Interaction Process Analysis (Bales, 1950), which is widely used in assessing group dynamics. Its basic distinction between task achievement and social achievement might be useful in continuously measuring task involvement and transactional involvement at the same time.

Objective coding systems as the aforementioned have, however, been criticized (Singer, 1974), and subjective scoring systems and methods advocated. A simple scoring by the subjects themselves of a video taped interaction appeared to be a reliable measure of the affect during the actual interaction (Gottman & Levenson, 1985). This method offers the possibility of continuous recording of subjective affect.

A method that extensively investigates the self as an organized system of valuations, the Self-Confrontation Method (Hermans, 1987), offers other possibilities. In a dialogue with the investigator, the subject reflects upon a set of important life issues taking place in past, present and future. The subject then labels each element of the set and subsequently scores each label on a range of affects. Among the indices that can be derived is a measure of topic involvement. A video recording of this dialogue, with concomitant blood pressure measures taken, offers a unique opportunity to study interpersonal communication.

Considering all of the above, we may now be in a better position to further investigate the ultimate question of which specific situational factors cause which specific blood pressure changes (or patterns) in which specific types of individuals.

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Communication Behaviors that Affect Blood Pressure: Differential Effects as a Function of Self-Involvement *

Gérard Näring, Cas Schaap & Hubert De Mey #

The current experiment was a replication study of changes in blood pressure (BP) during marital interaction. The interaction of a couple was recorded during discussions while the BP of the hypertensive man was repeatedly measured. During two phases, as part of an A-B-A-B design, the interaction of the couple was manipulated through a communication training and the number of verbal responses that hampered problem solving was consequently lowered. Self-involvement and duration of speech of the man, and nonverbal interaction behaviors were additionally measured in the replication. In contrast to the findings of the original experiment, no relationship was found between BP increases and the various categories of verbal communication. As the definition of the reactivity measures makes their reliability questionable, we performed additional analyses on absolute BP levels. Self-involvement, as measured by number of self-references, correlated positively with systolic BP during discussions on hypothetical problems but not during discussions on personal problems. Because the two types of interaction differed in communication characteristics, it was suggested that the hypertensive man interacted differently in discussions on personal problems as compared with discussions on hypothetical problems. This was accompanied by different physiological reaction patterns.

Essential hypertension, a chronically elevated blood pressure (BP) without demonstrable physical cause, is known to be the most important risk factor for cardiovascular disease. Psychological research on the factors involved in the etiology and treatment of essential hypertension has focused on intra-individual characteristics, such as neuroticism and depression, on behavior patterns such as Type A/B behavior, and on the role of emotions such as fear and aggression. Because BP levels may vary considerably over the course of a day, a number of authors have drawn attention to environmental factors that influence BP, particularly social interactions (for a review see Näring, De Mey, & Schaap, 1988).

One line of research focused on the influence of the content of social interactions (e.g. Kaplan, Gottschalk, Magliocco, Rohovit, & Ross, 1961; Adler et al., 1976-1977). Emphasis was placed on the role of the emotions of anger and anxiety, which might differentially influence systolic BP (SBP) and diastolic BP (DBP).

A second line of research emphasized speech-related variables and showed that BP is elevated by the act of speaking itself (Lynch, Long, Thomas, Malinow, & Katcher,

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1981). The magnitude of this increase was found to be greater in hypertensives than in normotensives and appeared to be independent of content (McKegney & Williams, 1967).

In a third line individual difference variables were stressed. Of particular interest in social interaction was the observation that Type A individuals used self-references twice as much in verbal interaction as Type B individuals. A more self-involved style of speaking was found to be related to higher levels of BP in Type A individuals (Scherwitz, Berton, & Leventhal, 1978).

Other investigators have emphasized interpersonal variables, asserting that the style and the nature of the interaction might be more important than the topics discussed. Williams, Kimball and Williard (1972) reported that patients telling a physician, who only listens passively, about emotional topics, showed an increase in BP. A significantly greater increase, however, was reported if the same physician asked questions and gave comments. Since in the latter interview one might assume that the participants were more engaged, it has been hypothesized that this transactional involvement constitutes a central mechanism in psychophysiological processes (Singer, 1974).

Within this interpersonal context the relation between gaze and gaze aversion on the one hand and hypertension on the other has been investigated. Families with normotensive and hypertensive fathers were observed during a conflict situation in the laboratory (Baer et al., 1983). While the number of positive and negative utterances did not differ between the two groups, the percentage of time the members of a family did not look at each other was significantly higher in the families with a hypertensive father. An interpretation in terms of conflict-avoidance was suggested by the authors.

These studies point toward a link between essential hypertension and difficulties in perceiving and responding to social threats. A flight into a low level of involvement might often be taken as a solution. We need, however, much more information on the effect of frequently occurring social stimuli on the pressor response, to be able to make valid statements concerning this possible link.

A study by Ewart, Burnett and Taylor (1983) revealed that specific elements in social interaction influenced BP levels. Two male hypertensives and their wives were studied two to four times a week during marital problem solving sessions. The experiment lasted four weeks. The marital interaction was manipulated by a communication training during the second and fourth week of the experiment. In these two weeks the number of disruptive responses of the couple during problem solving discussions diminished and BP reactivity of the hypertensive man decreased. The authors concluded that a positive relationship existed between the two variables.

A close scrutiny of the data from Couple 1 in that study revealed, however, that in the third week, a return-to-baseline situation, the number of disruptive responses was twice as large as in the first week, the baseline period, while the SBP reactivity was reduced to almost 50 % of the reactivity in the first week. This renders the suggested positive relationship questionable. Due to a lack of data, the same comparison for Couple 2 was not possible.

Other researchers hypothesize involvement to be more important in determining BP level than other characteristics of an interaction (Singer, 1974). Furthermore, a change in the time spoken by the man might be a sufficient explanation for the change in his BP reactivity (Lynch et al., 1981). To clarify this issue, we decided to replicate the experiment and to additionally measure time spoken by the hypertensive man and his involvement. As the importance of nonverbal behavior is clear from the foregoing, we also measured nonverbal behavior during the interaction.

Method

Subjects

One couple participated in the experiment. Six years previous to the assessment, the man was diagnosed as having essential hypertension, after being hospitalized for unbearable headaches. For the year and a half prior to the experiment, the subject agreed with his family physician to use a ß-blocker (150 mg metoprolol) in periods of a heightened BP. The use of this medication was finished in the four days prior to the start of the experiment by diminishing it by 50 mg per day. On the day of the start of the experiment, SBP measured at home with a semi-automatic sphygmomanometer was 143 mm Hg, DBP was 91 mm Hg. The score of the couple on the Maudsley Marital Questionnaire (Arrindell & Schaap, 1985) did not indicate marital problems. The man's age was 31, the woman's age 27. After having lived together for several years, they were married a year prior to the start of the experiment. The couple received Dfl. 430.- for participation in the experiment.

Apparatus and setting

BP and heart rate (HR) were measured with an automatic Dinamap 845 unit. All sessions took place in a video-studio that was furnished as a living room. The Dinamap was installed in an adjacent room, where the experimenter recorded the data.

Procedure

All sessions, except one, took place in the late afternoon. Before the start of the experiment the couple came to the laboratory and was given detailed information concerning the procedure to be followed. They then signed a declaration of informed consent and filled in some questionnaires (sociodemographic information, marital happiness, marital conflicts). In each session, the couple spoke with a female trainer who also gave the couple a discussion topic prior to videotaping. During the discussion she was not in the room. After 10 minutes the trainer re-entered the room and the discussion was ended. The same procedure was used for a second discussion.

Each of the 12 sessions started with either an interview or a communication training (lasting approximately 45 min), followed by a first baseline (6 min), a first discussion (10 min), a second baseline (6 min), a second discussion (10 min) and a third baseline (6 min).

During the baseline periods, the trainer and the couple chatted about a topic, unrelated to emotional stress, and three BP measures were taken at intervals of two and a half minutes. During each discussion, the BP was measured four times, and the interaction of the couple was recorded on videotape.

The first videotaped discussion was a personal conflict, chosen during an interview with the couple, while the second discussion concerned a hypothetical disagreement presented in the form of vignettes. In the first session, three conflict areas were selected during the interview, guided by the information on the Questionnaire for Conflicts in Marriage (Schaap, Buunk, & Kerkstra, 1988). One of these three conflict areas was discussed in the first 10-minute marital problem discussion of a session. The three conflict areas were presented each week in a different order.

The second discussion in each session dealt with a hypothetical conflict, written in the form of vignettes (Inventory of Marital Conflicts; Olson & Ryder, 1970). Each vignette of marital conflict was presented in two versions: the man was given an account that presented the problem from his point of view, while the woman received an account that presented a conflicting point of view. Some vignettes were written especially for this couple and this experiment. The topics included conflicts over money, friends and household chores. The couple was instructed to imagine as vividly as possible the situation that was depicted in the vignette and to try and solve the conflict presented.

As depicted in Table 1, the experiment lasted four weeks, with three sessions during each week.

Table 1
Diagram of the experiment

Design	A1	B1	A2	B2
Week	1	2	3	4
Activity	Interview	Training	Interview	Training
Sessions	1-3	4-6	7-9	10-12

During the 2nd (B1) and 4th (B2) week of the experiment, the couple received a communication training program, accompanied by homework assignments (Ewart, 1981). The communication training program was taught in terms of a stress management approach in which dysfunctional communication was viewed as source of stress. The training procedure was adapted from the one used in another experiment by Ewart et al. (1984).

An important ingredient of the program was a self-help book (Gottman, Notarius, Gonso, & Markman, 1976) wherein fundamental communication skills were described. The spouses were first presented with a procedure to handle conflicts. Then they were instructed to listen attentively, while paying attention to their own posture and eye-contact. Finally, they were taught to repeat the other's point of view before responding, with special attention given to empathy. During the 1st (A1) and 3rd (A2) week, the trainer gave no instructions during the interview. She let the couple talk about stressful events and explored the antecedents of these events and the thoughts and feelings that had accompanied them.

Measures

Cardiovascular measures. SBP, DBP, mean arterial pressure and HR of the man were measured by the Dinamap on the left arm, at approximately every two and a half minutes. The subject was seated and his arm was loosely fixated to the elbow-rest. The differences between the means of the eight BP and HR measures during the two discussions and the nine measures during the three baselines constituted the BP and HR reactivity indices of a single session.

Behavioral measures. Positive, neutral and negative problem solving behavior during the 10-minute discussions was measured by coding the videotaped interactions with the Marital Interaction Coding System (MICS; Weiss & Summer, 1983). The version used consisted of 30 verbal and nonverbal codes.

Two doctoral students independently coded each of the tapes with an agreement percentage ranging from 83 % to 97 % with a median of 88 %. On the basis of empirical research by Schaap (1982) of consequent behavior of the listener, the codes were separated into positive, neutral and negative categories, as shown in Table 2. Due to low frequency, the codes Paraphrase, Mindreading, Compliance, Non-compliance and Compromise were dropped from the analysis.

The percentage of the positive and negative codes occurring during a discussion was calculated by dividing the number of positive or negative codes in a discussion by the total number of codes in that discussion. This was done for the verbal and the nonverbal codes separately. The amount of speech was measured by counting the number of seconds the man spoke during a discussion. His level of self-involvement in a discussion was measured by counting the total number of self-references: I, me, my, and mine. Self-involvement was corrected for the time spoken by dividing the number of self-references by the number of seconds spoken.

Table 2
Positive, neutral and negative categories of the communication codes (MICS)

	Positive	Neutral	Negative
Verbal			
	Humor	Question	No Response
	Laugh	Problem Description	Disagree
	Agree	Normative	Interrupt
	Assent	Negative Solution	Criticize
	Approve	Positive Solution	Complain
		Talk	Deny Responsibility
		Accept Responsibility	Excuse
		Command	Put Down
Nonverbal			
	Attention		Not Tracking
	Smile		Turn Off

Method of analysis

A nonparametric randomization is used to test the hypothesis that negative communication codes, cardiovascular reactivity measures, speech duration and self-involvement follow the pattern A1 > A2 > B1 > B2 (p = .04). A weaker hypothesis stating $A_i > B_i$, $i = 1,2$ can only be tested marginally (p = .17; Levin, Marascuilo, & Hubert, 1978). Subsequent analyses consist of Pearson product moment correlations.

Results

Marital interaction measures. The couple completed 11 sessions. In the 3rd week they had to cancel one session. The behavioral data are depicted in Figure 1. The mean percentages for negative verbal MICS codes for the four weeks are 26.3, 14.1, 23.5 and 15.2, respectively. For the positive verbal codes these percentages are 33.5, 42.6, 36.3 and 39.2. The percentage of negative codes in Weeks B1 and B2, in which the communication training was given, is marginally lower than in Weeks A1 and A2 and an effect of the training is indicated. A separate coding of nonverbal behavior was also performed. For the negative nonverbal codes the percentages for the four Weeks are 5.9, 5.6, 7.6 and 13.6, respectively. Apart from two occurrences of another nonverbal code (Turn-Off) in Week 3, this reflects an increase in Not-Tracking. The latter code was given whenever the couple did not look at each other for three seconds or more. Mean duration of speech in a discussion of the man for Weeks 1 through 4 was 309, 290, 336, and 252 seconds, respectively. There is a marginal difference between

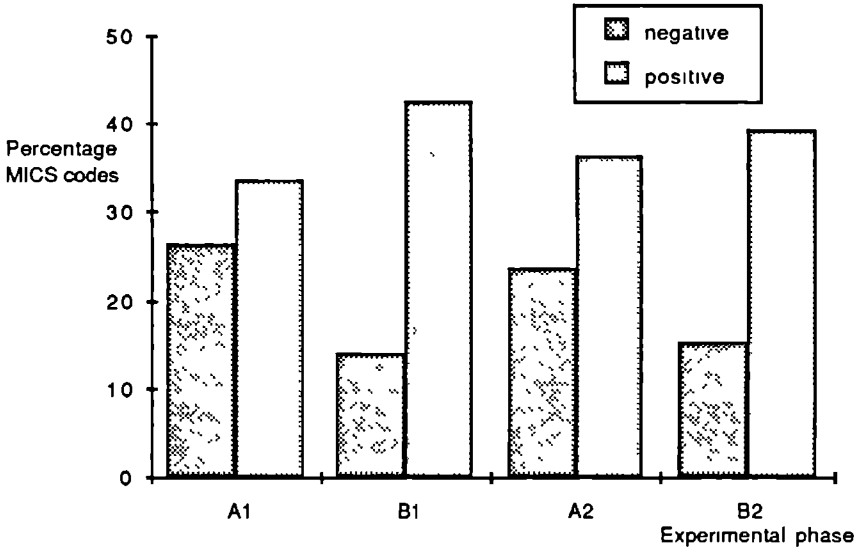

Figure 1. *Mean verbal communication codes of the couple during weeks with and without communication training*

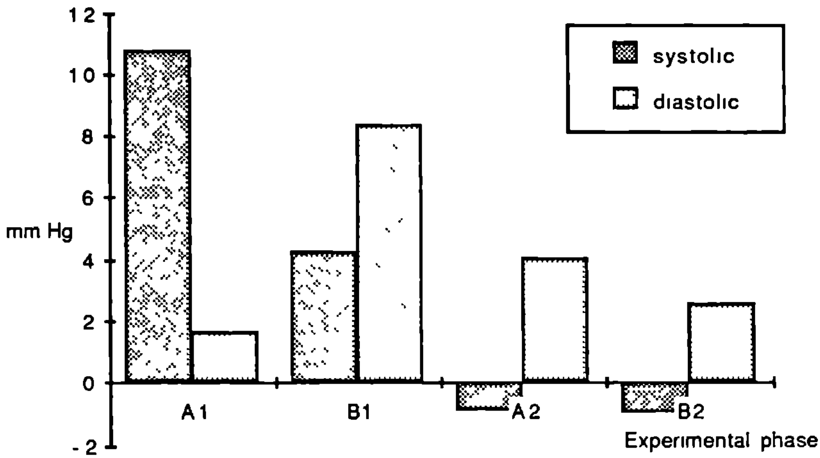

Figure 2. *Mean blood pressure reactivity measures of the hypertensive man during weeks with and without communication training*

duration of speech of the man in the two weeks in which the communication training was given and the two other weeks (Randomization-test, $p = .17$).

Cardiovascular measures. Figure 2 shows the change in BP from the preceding baseline obtained during discussions of hypothetical and personal conflicts in each experimental phase. Unfortunately, the Dinamap could only be used from Session 3 onwards, and thus the BP values of Week 1 consisted of one measure only. The change of BP during the two discussions with respect to the three baselines was averaged per week. The mean systolic reactivity for Week 1, 2, 3 and 4 was 10.8, 4.3, -0.9 and -0.9 mm Hg, respectively; the mean diastolic reactivity was 1.6, 8.4, 4.1 and 2.6 mm Hg. The negative systolic reactivity in Week 3 and 4 indicates that the average SBP was lower during the two discussions than during the three baselines.

It is clear that the data do not follow the pattern A1 > A2 > B1 > B2 as Ewart et al. predicted. This also applies to the reactivity measures of mean arterial pressure (3.9, 7.3, 4.3 and 1.0 mm Hg) and of HR (1.9, 4.6, 3.7, 1.8 bpm). Systolic reactivity decreased steadily over four weeks. Diastolic reactivity was high in Week 2, the first week of the communication training, after which it also decreased.

Inspection of the percentages of negative MICS codes and the reactivity measures of each discussion separately, revealed a very large variability of these measures within Weeks and even within Sessions. We therefore performed subsequent analyses with discussions as the unit of analysis. Instead of 4 Week means, we analyzed 22 separate discussion means.

In yet another way we differed our method of analysis from that of Ewart and his colleagues. The negative systolic reactivity that was found in Week 3 and 4 indicates that during some baselines the interaction of the couple and the trainer increased the man's BP more than the interaction of the couple during discussions did. The reactivity measures are likely to be unreliable, since they are based upon the BP level during discussions of the couple and upon BP level during baselines in which a third person was present. Because the interaction during baselines was not videotaped, an analysis of BP during baselines is not warranted and thus we performed subsequent analyses on absolute BP levels of the discussions.

To detect systematic variations in the repeated measurements of the variables over the course of time, autocorrelations were calculated separately for the mean absolute BP and HR levels, negative and positive percentages MICS codes, and speech duration and involvement for the two types of discussions. There were no significant autocorrelations except for DBP level during personal problem solving discusssions ($r = -.60$ at lag 2, $p = .06$). DBP was excluded from further analysis and Pearson correlations can be computed of the other measures because they can be regarded as independent measures.

Marital interaction and cardiovascular measures. Pearson product moment correlations were calculated for percentage of negative and positive MICS codes of man and woman and speech duration of the man with absolute HR and SBP level. This was done for discussions on personal and hypothetical conflicts separately. A significant negative correlation between HR and percentage negative MICS codes from the man ($r = -.68$, $N = 9$, $p = .04$) was found during personal problem solving discussions. Other correlations did not reach significance.

Marital interaction and self-involvement. The relationship between self-involvement and MICS codes of the man is given in Table 3. Self-involvement is positively correlated with verbal negative MICS codes and negatively with verbal positive MICS codes. The latter is not surprising, as the code Assent, which is used for utterances such as 'hmm', accounts for 63 to 84 % of the verbal positive codes and never refers to utterances containing self-references. The correlations between self-involvement and the MICS codes of the wife are all in the same direction but do not reach significance.

Table 3
Within-subject correlations of cardiovascular measures and communication measures with self-involvement during the two types of discussions.

	Self-involvement	
	Personal Problem	Hypothetical Problem
Systolic Blood Pressure[a]	-.20	.71*
Heart Rate[a]	-.74*	-.26
% Positive MICS Codes[b]	-.55#	-.39
% Negative MICS Codes[b]	.75**	.36

Note Pearson product moment correlations are reported.
[a] $n = 9$. [b] $n = 11$.
$^{*}p \leq .05$, $^{**}p \leq .01$, $^{\#}p = .07$ two-tailed.

Self-involvement and cardiovascular measures. The correlations between the measure of self-involvement, i.e. number of self-references, and cardiovascular measures are also given in Table 3. During discussions on hypothetical problems there is a significant positive relation between SBP and self-involvement. During discussions on personal problems from the Inventory of Marital Conflicts this relation is not present. Instead the correlation is negative, although no statistical significance is reached.

Task differences. To investigate systematic differences between discussions on personal problems and on hypothetical problems, a T-test for paired samples was performed on communication characteristics of the couple and on self-involvement, speech duration, SBP, and HR of the man. The man's mean percentage negative verbal codes of the discussions on hypothetical problems (M = 21.4%) was significantly higher than that of discussions on personal marital problems (M =

11.4%), $T = 2.63$, $p = .03$. A similar difference was found in the woman's percentages negative verbal codes (hypothetical: $M = 31.0\%$, personal: $M = 16.4\%$; $T = 2.47$, $p = .03$). No difference was found in self-involvement, speech duration, SBP, and HR of the man between the two tasks.

Discussion

In this study we replicated an experiment of Ewart et al. in which BP was found to be affected by certain classes of social stimuli. Our results do not support a positive relationship between BP reactivity and negative verbal behavior.

The reactivity measures as used in the Ewart study have, however, a questionable reliability. While BP reactivity measures were made up of data from baselines and discussions, the behavioral data consisted of measures taken during discussions only. As the mere presence of another person may influence BP (Innes, Millar, & Valentine, 1959), baselines and discussions do differ substantially. For the couple in our experiment, sometimes a dull interaction (between the spouses) was preceded or followed by a lively chat during baselines with the trainer, resulting in considerable BP rises. Even in a baseline during which no verbal interaction takes place, considerable rises in physiological measures were observed (Levenson & Gottman, 1985). We concluded that the reactivity measures were unreliable. Reliable baseline values of physiological parameters should maybe be obtained in a separate session in which no interaction takes place and each spouse visits the laboratory separately (Levenson & Gottman, 1985). For the present data, only analyses on absolute levels of SBP and HR are appropriate.

The measure of self-involvement gives promising results. Scherwitz et al. (1978) found that Type-A subjects who self-referenced more frequently, had a higher SBP than those who did not. This relationship was found during the Type A/B interview and during anger provoking situations. Our subject showed a higher SBP during discussion on hypothetical problems when he self-referenced more frequently. During discussions on personal problems this relation was not present. Instead a strong negative relation between self-involvement and HR existed. There appears to be a different relationship between these behavioral and physiological variables depending on the discussion task.

That the two discussion tasks differ is illustrated by the finding that negative verbal behavior occurs more often during discussions of hypothetical problems than during discussions of personal problems. This applies to each of the partners separately. Other studies also report more explicit positive as well as negative behavior during discussions on hypothetical problems than on personal problems. In discussions on personal problems, husband as well as wife might be more inhibited, a tendency that seems to be stronger for men (Gottman & Levenson, 1988).

The gradual increase in negative nonverbal MICS codes suggests that this short communication training program was only effective on the verbal level. As there is evidence that gaze aversion is typical for families with a hypertensive father, it is quite possible that we have taught our subjects to flee into a low level of engagement (Singer, 1974) or the hypertensive man into non-attentiveness (Bittker, Buchsbaum, Williams, & Wynne, 1975). This might imply that communication training with hypertensives should focus more explicitly on nonverbal aspects Furthermore, trainers and researchers should pay attention to the difference in communication pattern during discussions on personal and on hypothetical problems.

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A System for Sampling Changes in Blood Pressure from a Videotape

Gérard Näring, Jos Wittebrood, Cees van der Staak, Hubert De Mey, and Cas Schaap

A system is described that measures blood pressure noninvasively and continuously during a videotaped verbal interaction. The system incorporates the use of the Finapres to nonintrusively and continuously measure BP during a verbal interaction. Segments from the interaction, in which blood pressure changes are automatically traced. With this system the influence of specific emotions, behaviors, and speech on blood pressure can be examined.

Until recently, blood pressure during verbal interaction has been measured at intervals of 1 to 5 min. The development of noninvasive devices for the continuous measurement of blood pressure enables the study of blood pressure during verbal interaction on a microscopical level (Näring, De Mey & Schaap, 1988). We designed a system to videotape dyadic interactions while continuously measuring blood pressure of a person.

The main purpose of the system is to examine variables in dyadic interaction that are associated with blood pressure changes. The application will be described in which the computer logs blood pressure data indexed by videoframe, so that post-experimental analysis of the blood pressure data can identify epoques of blood pressure change and direct the video cassette recorder (VCR) playback to the record of the behavior that produced those changes

The physical system

Figure 1 presents the general physical layout of the blood pressure recording and analysis system. The system is made up of a Finapres™ blood pressure measurement system (designed by TNO, the Netherlands), an Apple IIe microcomputer equipped with an analog to digital conversion system with a parallel interface, a serial interface, a video camera (Panasonic WVP-G1), and a VHS video cassette recorder (VCR, Panasonic AG6200). The real time clock generator, remote control and video inserter were designed by our electronics department.

The Finapres is an instrument used to continuously monitor finger arterial pressure. The instrument operates according to the volume clamp method invented by the Czech physiologist Peñàz. The total finger arterial volume under an unloading finger cuff is measured with an infrared plethysmogram. This volume is then held

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™ Finapres is a registered trademark of Ohmeda, Madison WI, USA constant by modulating cuff pressure in parallel with intra-arterial pressure. The latter is performed by a wide bandwith electropneumatic servo system (Settels & Wesseling, 1985). Systolic, diastolic and mean arterial blood pressure as well as heart rate are computed and analog outputs for these measures are provided.

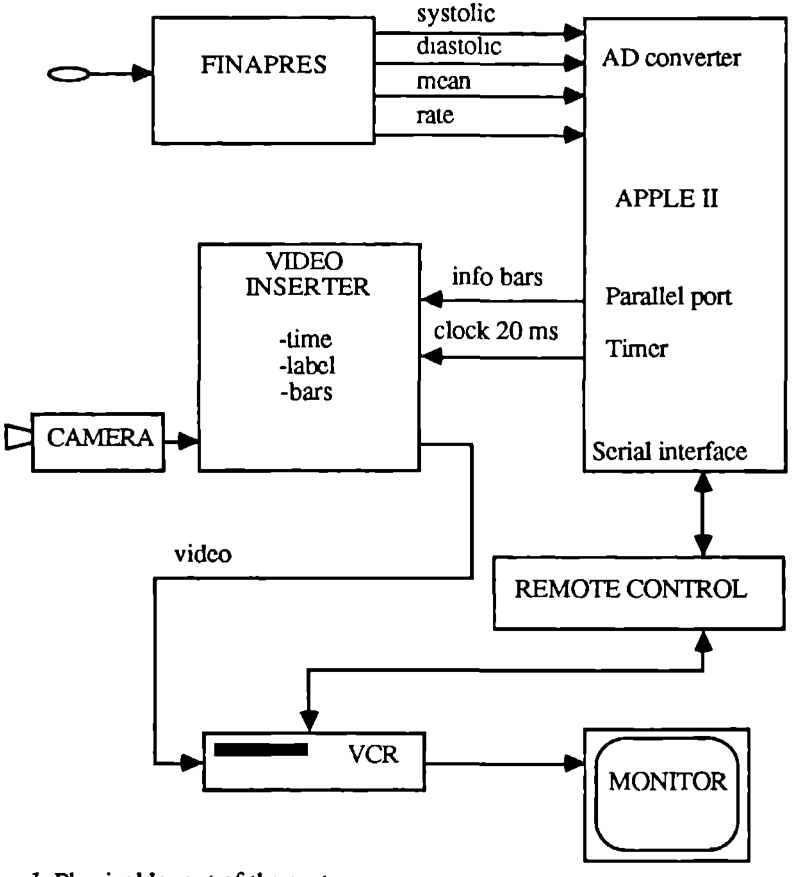

Figure 1. Physical layout of the system

Noninvasive measurements of finger blood pressure with the Finapres closely follow intra-arterial measurements (van Egmond, Hasenbos, & Crul, 1985). Arm-to-finger pressure differences vary across subjects, depending on subject age, blood pressure level, and technique used (Settels & Wesseling, 1985).

As the measurements are influenced by the relative position of the finger cuff to the heart a correct positioning of finger and subject is crucial. Positioning the finger about 10 cm below heart level is advised to obtain good estimates of brachial pressure. In order to fix this position we first asked our subjects to keep the arm in a sling. As it appeared that subjects still raised their arms too often, we tried a second more successful solution, broadening the elbow-rests of an armchair so that the arms of the subject could firmly rest on them. The left arm was fixated to the elbow-rest with a bandage. Due to hydraulic influences finger blood pressure measurements obtained this way overestimate brachial pressure.

The video inserter was used to provide continuous labeling of the videotape with a time clock, a session label and two horizontal bars. The clock is based on the MM5318 and MM5841 devices from National Semiconducter, that are used in TV sets to insert time and channel number onto a screen. Instead of using the electric mains frequency as a clock, the computer generates clockpulses that are converted to seconds. Information from this clock and from the Finapres is stored in one file. The channel number is used to label the recordings with a subject code. Systolic and diastolic blood pressure are inserted separately as two horizontal bars on the bottom of the screen. The length of the bars is adjustable by the computer in a range from 0 to 127.

The remote control is used, as shown in Figure 1, to control the videorecorder. This device is based on a single chip microcomputer. We used a 6511Q system from Rockwell. The single character commands are stop, rewind, play, record, pause, get track counter and reset track counter. The track counter gives a relative number to a picture. Incrementing or decrementing depends of course on the direction of the tape.

The analog to digital conversion system is based upon the Data Acquisition System (DAS) AD7581 from Analog Devices. It is an eight bit, eight channel system. The parallel interface and real time clock are based on a Versatile Interface Adapter (VIA) R6522 from Rockwell.

Blood pressure data recording

Figure 2 presents a flowchart of the data collection routine. During the interaction the continuous analog blood pressure output of a subject is sampled every 2 seconds. The Finapres generates a new blood pressure value at each heartbeat, but for statistical reasons we preferred to sample at equidistant time intervals.

The videotape of the interaction includes the continuous labeling with time, session label and blood pressure bars.

The microcomputer performs the data collection of both blood pressure and track counter of the remote control and stores these in one file. The computer generates clock pulses for the video inserter and adjusts the length of the blood pressure bars. The microcomputer is also used to start and stop the videorecording by means of the remote control.

The main programs have been written in UCSD Pascal. For data collection, remote control of the VCR, generating clockpulses, and updating the bars machine language was used.

After initiation, the data collection is performed in the background of the main program by an interrupt routine, as shown in Figure 3.

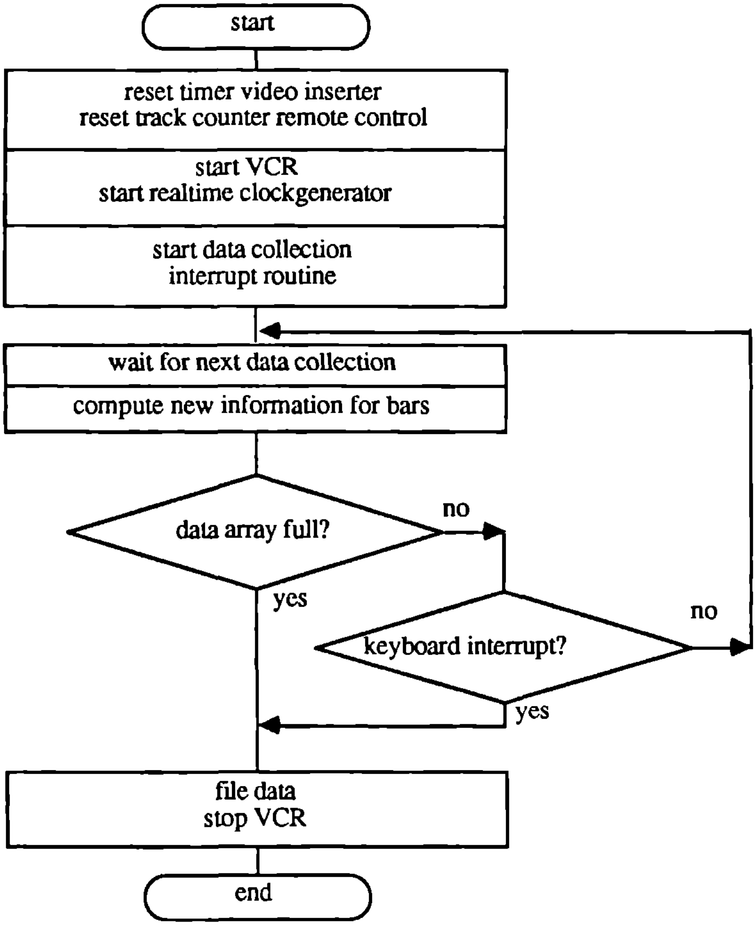

Figure 2. Flow diagram of the data collection routine

This interrupt routine is also responsible for updating the bars and generating clock pulses for time at the video inserter. In the main program track is kept of the number of registrations that has taken place. This enables the immediate processing of new data for statistical or graphical purposes.

Blood pressure analysis and VCR processing software

In order to identify segments of the dyadic interaction during which blood pressure increases, difference scores of each measurement and the previous one were computed. Occasional systolic blood pressure values of less than 40 and diastolic values of less than 15 were considered artefacts. Difference scores of a pair of values

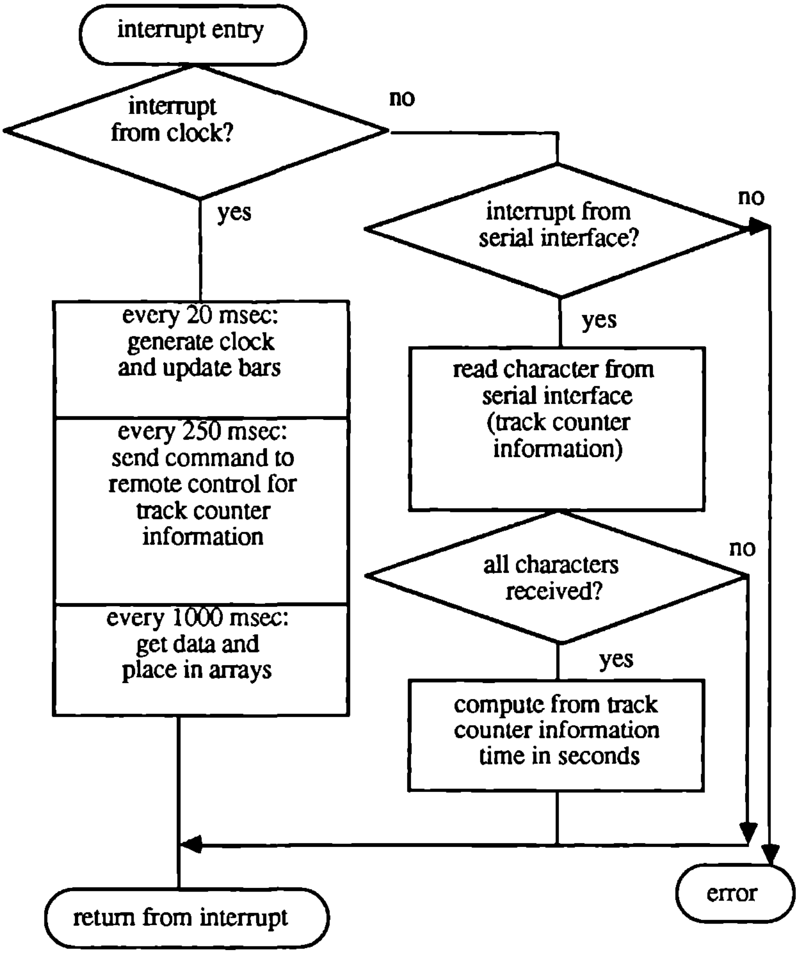

Figure 3. Flow diagram of the interrupt routine

of which one or both was an artefact were set to zero. The elements of the series of difference scores will further be referred to as plusses, minuses and zeros. A criterion for a substantial rise in terms of a number of consecutive plusses did not work. Blood pressure fluctuates in such a way that only small series of two or occasionally three consecutive plusses can be found. In a sequence of more than three observations, a series of plusses is usually interrupted by minuses or zeros on various places. A rise can thus only be defined by a percentage of plusses in a series. The magnitude of the rise was defined as the difference between the maximum and the minimum in the series.

At present, little is known about specific behaviors that influence blood pressure, and even less is known about the time that elapses between behavior and a blood pressure rise caused by that behavior. We decided to examine sequences of at least 16 seconds and explored several combinations of the number of plusses in a sequence of systolic difference scores. Concurrently, the same approach was used to find drops in blood pressure. It appeared that a criterion of 60% or less plusses or minuses in a series did not discriminate between rises and drops. A slightly higher percentage discriminated well and applied to a sequence of eleven scores the magnitude of the total rise within the sequence tended to become maximal. A longer sequence usually included a steady state or a subsequent drop in blood pressure. A higher percentage hardly detected any rises in a 20-minute session. In hypertensives the best criterion for a rise appeared to be seven plusses in a sequence of eleven scores. This equals a percentage of 63.6. Using this criterion, excerpts of an interaction with a duration of 22 seconds could be identified which were accompanied by a rise in systolic blood pressure. Since we were primarily interested in rises, we did not explore whether this criterion was also the optimal one for drops.

The program PREXCERPTS provides prints of the start and finish time of the excerpt and of the difference between the lowest and highest value in the segment of the interaction. The program SHOWEXCERPTS automatically shows the excerpts from the interaction one by one on performing a keypress. It requires that the videotape is placed manually at the start of the interaction.

Other applications

The system can easily be adapted for other applications. We included a mini key-board to couple up to five different codes to blood pressure measurements. This facility was designed to enable a subject to encode the degree to which he or she experienced a specific emotion, while reviewing a recording of an interaction. Self-report affective data obtained in a video-recall procedure of a marital interaction have proven to be valid measures of the affect during the actual interaction (Gottman & Levenson, 1985). The validity in other dyadic interactions has yet to be established.

The mini key-board can also be used to label blood pressure measurements with flags that indicate whether the subject was speaking or listening at the time of measurement. The influence of speaking on the blood pressure has been established (Lynch, Long, Thomas, Malinov, & Katcher, 1981), but needs refinement.

Additionally, it is made possible to register simultaneous data of a Dinamap, an automatic device that measures blood pressure with an arm cuff at intervals of 1 min or more. The relation between the two types of blood pressure measures is idiosyncratic and has to be assessed for every subject separately, when arm-to-finger differences are of interest.

To date, in psychological laboratories measurement of blood pressure was only possible at intervals of 1 minute or more. The development of the Finapres made noninvasive, continuous measurements of blood pressure more easily available. Used within the system that we described, one can now analyze blood pressure during verbal interaction at a microanalytic level.

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Continuous Measurement of the Blood Pressure Response of Normotensives and Hypertensives during Reading#

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Experiments on the response of blood pressure (BP) to speech were critically reviewed. Based on this review, it was concluded that evidence to support the assumption that the BP response to speech is higher for hypertensives than for normotensives is insufficient. Nevertheless, this assumption has to be clarified before the study of BP in situations that presuppose speech is undertaken. The present investigation addressed this issue by asking 13 normotensives, 10 unmedicated hypertensives and 13 hypertensives on medication to (A) sit quietly, (B) read subvocally and (C) read aloud for 1-min periods in an ABCBCA design. BP was measured noninvasively every 2 seconds. Results indicated that the average BP response to reading aloud versus reading subvocally did not differ between normotensives and hypertensives. Hypertensives, however, demonstrated a faster response as well as a higher BP response during the subvocal reading task.

Alexander (1939) was the first to draw attention to the potential vigorous impact of a personal discussion upon blood pressure (BP). Since then, numerous studies have identified conversational variables that have an influence on BP (for a review see: Näring, de Mey, & Schaap, 1988). Among the variables investigated are: the content of a conversation, emotions, including anger and anxiety, transactional involvement, individual difference variables such as Type A/B behavior patterns and hypertensive state, and speech-related variables.

The systematic study of the influence of speech-related variables on BP was only possible after (semi-)automatic devices for measuring BP became available. Previous to such devices, the influence of speech on BP was obscured because a stethoscope was used which required the subject to be silent during measurement. Only Adler, Herrmann, Schäfer, Schmidt, Schonecke, & von Uexküll (1976-77), using an invasive method, mentioned the possible influence of rate of speech on BP. Using an oscillometric device, a Dinamap, James Lynch and his co-workers undertook a whole series of experiments, mostly on normotensives, on the effects of speech on BP and heart rate (HR). In a review of these experiments, Linden (1987) concluded that speaking and reading aloud trigger significant increases in systolic BP (SBP), diastolic BP (DBP), and HR. Furthermore, he concluded that the response is evident at all ages and is not differentially affected by gender. The response has also been found to be higher when the experimenter has a high status and virtually absent when reading is subvocal. Finally, it was concluded that BP responses in hypertensives appear to be marginally higher than in normotensives, while HR responses are of equal magnitude.

submitted to Psychosomatic Medicine

Table 1
Studies on Blood Pressure during Reading Aloud or Talking in Normotensive and Hypertensive Subjects

McKegney, Williams, 1967
tasks: Word Association Test (WAT); Personal Discussion (PD); Thematic Apperception Test (TAT)
duration: baseline (WAT) 15 minutes, Personal Discussion 15 minutes, Thematic Apperception Test 15 min
medication: not mentioned

	SBP			DBP			MAP			HR		
	bas	+/-	%	bas	+/-	%	bas	+/-	%	bas	+/-	%
hypertensives (13)	-	-	-	-	9.1	-	-	-	-	-	-	-
normotensives (10)	-	-	-	-	7.4	-	-	-	-	-	-	-

Statistics: Wilcoxon Rank Test on differences in DBP between PD and WAT; hypertensives show larger differences.
Measuring Device: Goddart Haemotonograph

Lynch, Long, Thomas, Malinow, Katcher, 1981
task: talk about your work
duration: baseline 2-5 minutes, task 2-3 minutes
medication: 25 of 30 hypertensives medicated

	SBP			DBP			MAP			HR		
	bas	+/-	%	bas	+/-	%	bas	+/-	%	bas	+/-	%
normotensives (15)	124	8	6	72	10	13	89	9	10	73	6	9
hypertensives (30)	148	7	5	84	10	12	101	16	16	79	5	7

Statistics: Analysis of variance on change scores: no significant difference between groups
Correlations of baseline with change scores:

	SBP	DBP	MAP	HR
normotensives (15)	-	-	-	-
hypertensives (30)	-	-	.76	.02

Lynch, Thomas, Long, Malinow, Friedman, Katcher, 1982 (similar to previous experiment by Lynch, 1981)

	SBP	DBP	MAP	HR
normotensives (92)	.42	.34	.51	.43
hypertensives (30)	.04	.37	.72	.02

Statistics: Correlations of baseline values with change scores
Measuring device: Dinamap

(continues on next page)

Table 1 (*continuation*)

Malinow, Lynch, Thomas, Friedmann, Long, 1982
task: talk about your work
duration: baseline 4 minutes, task 2 minutes
medication: some hypertensives medicated

	SBP			DBP			MAP			HR		
	bas	+/-	%	bas	+/-	%	bas	+/-	%	bas	+/-	%
normotensives (20)	125	8	7	71	10	14	88	9	11	76	5	6
hypertensives (20)	151	14	9	87	14	16	109	13	13	81	5	6

Reported baselines are baseline B (second 2 minutes)
Statistics: analysis of covariance on absolute measures using baseline A (first 2 minutes) as covariate.
No significant difference between groups on any measures
Remarkable: HR higher in pre-baseline than in post-baseline; MAP more reactive than SBP or DBP (n.s.);
Magnitude of increase greater in hypertensive (n.s.)
Measuring device: Dinamap

Dimsdale, Stern, Dillon, 1988
task: mental arithmetic, cold pressor, stress interview
duration: baseline 3 minutes, mental arithmetic 3 minutes, cold pressor 3 minutes, stress interview 16 minutes
medication: none

	SBP			DBP			MAP			HR		
	bas	+/-	%	bas	+/-	%	bas	+/-	%	bas	+/-	%
normotensives (24)	-	20	-	-	15	-	-	-	-	-	-	-
hypertensives (19)	-	25	-	-	20	-	-	-	-	-	-	-

Statistics: Repeated measures analysis of variance on absolute values, Factor Groups x Tasks not significant.
Peak increases: normotensives: 31/24; hypertensives: 38/32
Measuring device: Dinamap

SBP: systolic blood pressure (mmHg); DBP : diastolic blood pressure(mmHg); MAP : mean arterial pressure(mmHg);
HR : heart rate(bpm); bas : baseline; +/- : change during task; % : percentage change of group mean

The latter conclusion regarding a difference between normotensives and hypertensives is crucial. If hypertensives show a higher response to speech than normotensives, a role of speech pattern (Friedmann, Thomas, Kulick-Ciuffo, Lynch, & Suginohara, 1982) and respiration activity (Linden, 1987) in the etiology of hypertension may be indicated. If a difference is only observed during verbal interaction, other variables as engagement level (Singer, 1974) or the perceived stressfulness of social interactions may be relevant.

It should be noted that Linden draws his final conclusion from nonsignificant results of only two experiments. In order to shed more light on the BP response to speech we re-examined the experiments reviewed by Linden together with similar experiments by other researchers. Some experiments (Hellman & Grimm, 1984; Silverberg & Rosenfield, 1980) included solely hypertensives, whereas others used mixed groups of normotensives and hypertensives (Ulrych, 1969). In five experiments, normotensive and hypertensive individuals were compared with each other (Malinow, Lynch, Thomas, Friedmann, & Long, 1982; McKegney & Williams, 1967; Lynch, Long, Thomas, Malinow, & Katcher, 1981; Lynch, Thomas, Long, Malinow, Friedmann, & Katcher, 1982; Dimsdale, Stern, & Dillon, 1988). Table 1 summarizes these experiments in which BP was measured in hypertensives as well as normotensives during reading aloud or talking to a person.

In these studies, most of the subjects were on medication, and were asked to talk to the experimenter. In one study a statistically significant difference between hypertensives and normotensives was found in BP response during a personal discussion as compared to a Word Association Test (McKegney and Williams, 1967). Other researchers found no significant difference, but suggested a larger response in various ways. Malinow reported no significant difference between his groups using an analysis of covariance on absolute scores, but nevertheless mentioned that the magnitude of the response in Mean Arterial Pressure (MAP) in hypertensives appeared to be greater than in normotensives. Lynch et al. (1981) compared a hypertensive group with a normotensive group, using an analysis of variance on change scores, and found no significant difference. In another article on the same hypertensive group, he reported, however, higher correlations between baseline and change scores in hypertensives than in normotensives (Lynch et al. 1982). Dimsdale et al. (1988) studied borderline hypertensives (SBP > 140 and/or DBP > 90) and normotensives during three tasks: mental arithmetic, the cold pressor test and a stress interview. They entered absolute BP values into a repeated measures analysis of variance with a factor Diagnosis and a factor Tasks. There was no interaction of the factor Tasks with the factor Groups, indicating a similar response pattern of normotensives and hypertensives during tasks. Subsequently larger average peak responses in SBP and DBP were reported during the stress interview in hypertensives, but these were not statistically tested.

In conclusion, these experiments do not provide convincing evidence that hypertensives show stronger MAP and/or DBP elevations during speech than normotensives. This lack of differentiation between groups might, however, be due to the use of antihypertensive medication by most of the subjects in the speech studies, which may have led to an attenuation of the response. If that is the case, one would expect hypertensives without medication to show a higher response.

Furthermore, the tendency towards a higher response was only reported when subjects talked to the experimenter. None of the experiments compared normotensives and hypertensives during reading or counting. Whether these groups differ in their BP response to speaking without interacting is thus unclear.

Finally, the previously used techniques generally limited the measurement of BP to intervals of one minute or more. Through this intermittent recording, differences in BP response may not have been detected. The present study overcomes this restriction by using a new method that measures BP continuously and noninvasively without the drawback of the use of the invasive method of catheterising human subjects. The instrument, the Finapres, developed by TNO (Utrecht, The Netherlands) and Ohio Medical Products (Madison, WI, USA), measures BP reliably (Settels & Wesseling, 1985) with a fingercuff.

The present study was designed to assess the influence of speech on BP in normotensives and hypertensives in a setting that required no interaction. To ensure minimal interaction the experimenter only interacted while giving task instructions to subjects. As the cognitive activity associated with reading may influence BP, we measured this separately by requiring subjects to read subvocally and aloud. Apart from normotensives and untreated hypertensives, a group of hypertensives on medication was included in order to assess the influence of medication. To monitor the response more precisely, we used a device that enabled us to measure BP continuously.

Method

Subjects

Thirty-six subjects participated in this study, 13 hypertensives on medication, 10 untreated hypertensives and 13 normotensives. Selection criteria were as follows: for normotensives (1) no medical history of hypertension and (2) BP values of < 160 mm Hg SBP and < 90 mm Hg DBP; for hypertensives (1) a diagnosis of essential hypertension, excluding a physical cause, by a physician and (2) BP values of > 90 mm Hg DBP and/or > 160 mm Hg SBP. For hypertensives on medication, no BP criterion was used. The antihypertensive medication of the subjects is given in Table 2.

Apparatus

The Finapres was linked to an Apple II^{e} computer with an analog to digital conversion system with a parallel interface. Furthermore, it comprised a serial interface, a video camera (Panasonic WVP-G1), and a VHS video cassette recorder (VCR,

Table 2
Number of subjects using a specific drug combination

Number of subjects	Antihypertensive Medication
5	b-blocker
2	b-blocker + diuretic
1	b-blocker + Angiotensin-Converting-Enzyme-blocker + diuretic
3	Angiotensin-Converting-Enzyme-blocker
1	Angiotensin-Converting-Enzyme-blocker + diuretic
1	diuretic

Panasonic AG6200). A real time clock generator was designed by our electronics department. A computer program, written in machine language and UCSD Pascal, was used to perform data collection, to control the VCR-remote-controller and to generate clockpulses. SBP, DBP, MAP, and HR were collected from the Finapres every two seconds. The program was started as soon as the subject was ready for the first task. Via a monitor, which was placed behind the subject, the experimenter was able to give a new instruction exactly at the start of a new minute. Using this rather complicated procedure and set-up, we were able to ensure an exact labeling of this BP measure with actual time.

Arm-to-finger pressure differences depend on subject age, BP level and technique used (Settels & Wesseling, 1985). In order to enable a comparison with other studies and for sample selection, blood pressure was also measured with a Dinamap model 845 using an arm cuff.

Design

The design includes a period of rest as a baseline (A), a period of subvocal reading (B) to assess the influence of cognitive activity associated with reading, and a period of reading aloud (C). Reading a neutral text instead of a conversation was chosen as an activity to minimize the effect of topic-involvement and of human interaction, and to assure a continuous flow of words. The elements B and C are repeated to replicate the effect within subjects. This repetition of activity also simulates the alternation between silence and speech as occurring in natural speech. Baseline periods are situated before and after the reading tasks resulting in an A-B-C-B-C-A design. Since it has been established that the response of BP occurs within one minute (Malinow, 1982), each activity lasted one minute.

Procedure

Participants were informed that they would be asked to read subvocally and aloud for some minutes during which time their BP would be measured every 2 seconds. They were told that no attention would be given to how they read the text and that it was not important whether they would finish it or not. The functioning of both the Finapres and Dinamap was explained. The cuff of the Dinamap was placed on the right arm, while the cuff of the Finapres was placed on the ring-finger of the left hand. The left arm was loosely tied to the elbow-rest of the chair. The subject was asked to relax and told that he/she would be left alone while, after 5 minutes rest, three measures with the Dinamap would be taken. After 5 minutes both measuring devices were started up and three measures of SBP, DBP, MAP and HR were obtained from the Dinamap at intervals of 2 minutes. The experimenter then entered the room and removed the cuff of the Dinamap. He explained more precisely what the subject had to do and indicated that he would briefly repeat the instructions at the start of each minute. The subject received a sheet with the blank side up and was asked to look at the sheet and relax again. After 1 minute, the experimenter asked the subject to turn the sheet and to start reading subvocally. On the reverse side of the sheet an article on ecological pollution from a newspaper was printed. After another minute an instruction to read aloud was given. Similar brief instructions were given at the start of each minute.

Initial data processing

The analog to digital conversion required an amplification of the analog signal. An amplification factor was chosen that ensured reliable digital measures in the range of 0 to 250 mm Hg. Two hypertensive subjects appeared to have Finapres SBP values exceeding this value of 250 mm Hg and were thus excluded from SBP analyses. All other SBP values of 250 were considered unreliable and treated as missing data. Thus, approximately 180 values of SBP, DBP, MAP and HR were obtained from each subject. Every 10 consecutive measures were averaged and these means were used in further analyses.

Method of analysis

One-way analyses of variance were used to compare age and baseline BP values of the groups. To assess the magnitude of the response, analysis of covariance using the baseline as covariate is advised even in the absence of significant baseline differences (Benjamin, 1967). Given the convincing evidence that the use of prestress levels as a baseline eliminates a substantial part of the individual differences which occur in response to stress (Light, 1981), a post-stress level as covariate is preferable (Matthews, Manuck, & Saab, 1986). We used a multivariate analysis of covariance with the last measures of the post-baseline as a covariate. The factors included are Groups (normotensive, hypertensive, hypertensive on medication), Tasks (subvocal reading, reading aloud), Repetition (first, second) and Periods (three means of each 10 measures within each occurrence of a task). For multivariate tests Wilk's Lambda is reported.

Results

Group characteristics

Subjects ranged from 21 to 67 years of age, the mean age was 23.8 for normotensives, 39.1 for hypertensives, and 43.3 for hypertensives on medication. Normotensives were significantly younger than both groups of hypertensives (F = 18.86, p < .000). ANOVA's revealed a significant difference during pre-baselines between groups for SBP, DBP, MAP and HR as measured with the Dinamap. The means of these measures are given in Table 3. Newman-Keuls comparisons showed a significant difference between normotensives and both groups of hypertensives on all three BP measures. There was no significant difference in BP between hypertensives with and without medication. The hypertensives on medication had a significantly lower HR than both unmedicated hypertensives and normotensives.

Table 3
Analysis of Variance on Pre-Tasks Cardiovascular Measures of the Three Groups [a]

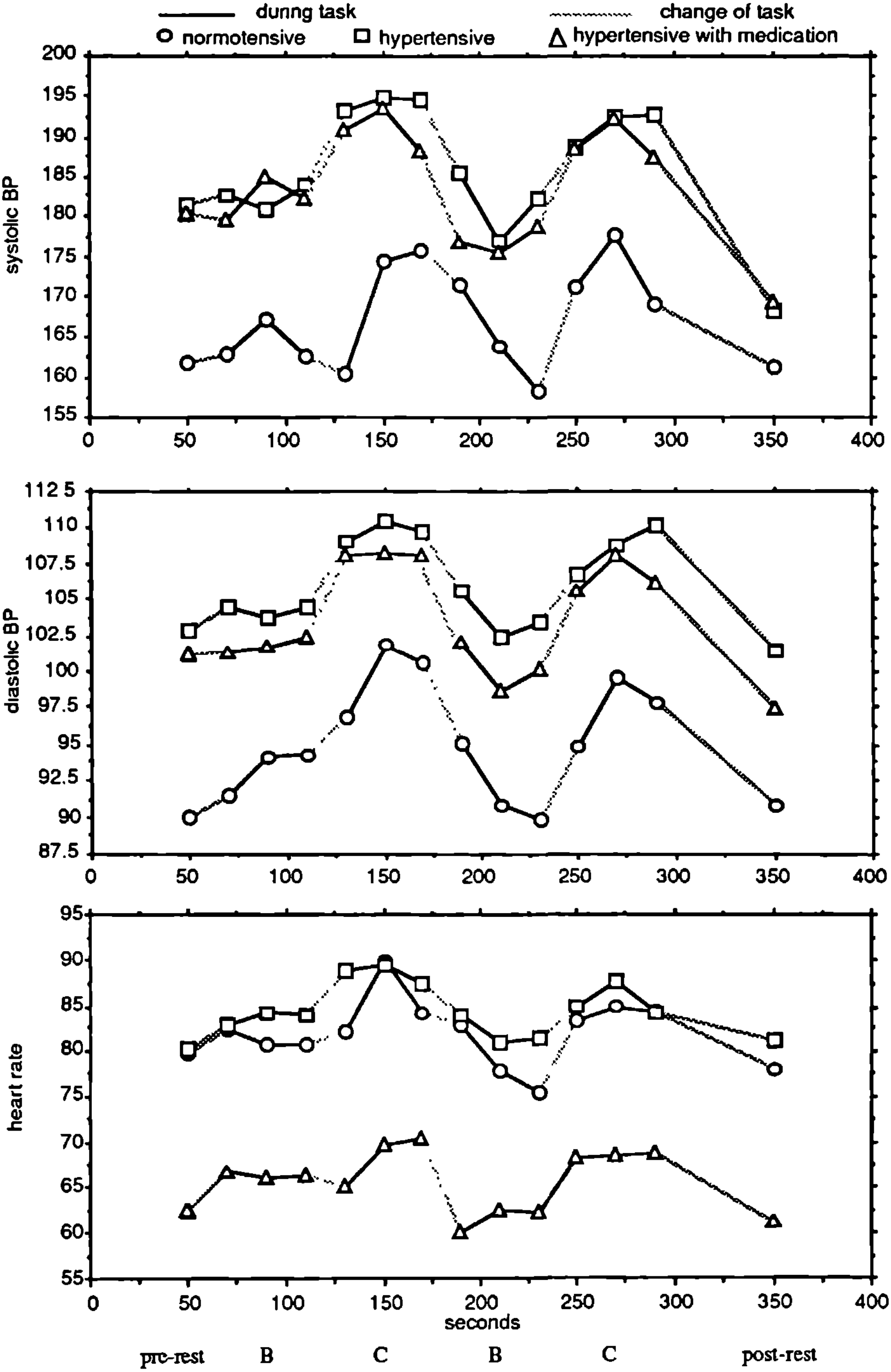
Variable	Group			F Value	p Value
	Normotensive	Hypertensive	Hypertensive on Medication		
Blood pressure					
Systolic	125.8#*	144.6#	145.8*	7.70	.002
Diastolic	73.3#*	95.5#	90.5*	13.77	.000
Mean arterial pressure	89.8#*	109.4#	107.7*	12.39	.000
Heart rate	81.4#	77.3*	62.6#*	9.65	.000

[a] Values are means of laboratory Dinamap measurements.
[b] Groups that differ significantly from one another are marked with the same symbol * or # (Student Newman-Keuls comparison).

Task Results

A multivariate analysis of covariance revealed a highly significant difference between Tasks for all four measures, indicating an influence of speech on all of the

Figure 1. Means of 10 consecutive finger blood pressure measurements and heart rate during 1-min periods of rest, subvocal reading (B), and reading aloud (C).



cardiovascular measures. The response to reading aloud compared to reading subvocally does, however, not differ between groups, as indicated by a nonsignificant Task by Groups interaction. The average magnitude of this response to speech is thus the same for every group.

The factor Groups is significant for SBP indicating a difference in SBP level that is not accounted for by the difference in baseline values. As can be seen in Figure 1 both groups of hypertensives show a higher SBP response to the combination of the two tasks than the group of normotensives.

The response of DBP and HR is not the same during each performance of the two tasks, resulting in a significant Repeat effect. Figure 1 shows that the response, especially during the second subvocal reading task, is lower. The pattern of the three consecutive means is significantly different between Tasks, as indicated by a Tasks x Periods interaction for SBP and DBP. Univariate tests demonstrated that this interaction is primarily due to a difference in a quadratic pattern, caused by a bell-shaped response during reading aloud and an opposite pattern during subvocal reading.

The significant Repeat x Periods interaction for DBP is caused by variations in the response pattern. Whereas a rise in BP during talking sometimes continues throughout the task, the response can also start lessening during the task or stabilize. The fact that this occurs in both tasks in a different way is indicated by a significant Repeat x Tasks x Periods interaction of DBP. Although not significant, the same tendency is seen in SBP.

The results of this analysis, together with analysis of the baselines and inspection of the figures indicates that the response in BP of hypertensives with medication does not differ from that of hypertensives without medication during baselines and tasks. On resting HR levels the medication does have a clear effect. This difference in HR level rules out joining the hypertensive groups for further analyses. We performed a second analysis on SBP, DBP and MAP in which the hypertensives were examined together in one group. The results are shown in Table 4. This analysis supports the results of the first analysis and reveals some additional findings. The factor Periods is significant for SBP and DBP, which is caused by a difference in quadratic trends. Groups x Periods is significant for DBP, which is also due to a difference in quadratic trends. The significant interaction Groups x Repeat x Periods in both SBP and DBP can be ascribed to a difference in level of these measures during the two performances of the tasks.

As shown in Figure 1, the pattern of the DBP within a task is mostly curvilinear in both groups. A rise that is initiated in the first 20 seconds of talking, continues through the next 20 seconds and then begins to fall. The difference between the groups lies in the proportion of the maximal rise that is reached in the first 20 seconds. On both occurrences, hypertensives almost immediately reach their maximum response to speaking, whereas the response in normotensives rises more gradually. During the second subvocal reading period, both groups not only show a pattern that differs from the first minute, but also reach levels as low as or below the pre-rest level.

Table 4
MANCOVA on the means of ten consecutive Blood Pressure Measures for two groups (hypertensives, normotensives)[a]

	SBP	DBP	MAP
groups	.015		.026
repeat		.010	
groups x repeat			
tasks	.000	.000	.000
groups x tasks			
groups x periods		.011	
periods	.011	.023	
repeat x tasks			
groups x repeat x tasks			
groups x repeat x periods	.048	.039	
repeat x periods	.022	.002	
groups x tasks x periods			
tasks x periods	.018	.001	
groups x repeat x tasks x periods			
repeat x tasks x periods		.000	

[a] Post-rest levels are entered as covariate
[b] Only p-values less than .05 are reported

Discussion

The results of this study do not provide evidence for a higher BP response to speech per se in hypertensives than in normotensives, as is indicated by a nonsignificant Groups by Tasks interaction. Differences between the two groups can be ascribed to an overall higher BP level of the hypertensives during subvocal reading and reading aloud, which is reflected in the significant factor Groups. Evidence of a faster response of hypertensives in DBP is however given by a significant Groups x Periods interaction.

The findings confirm that the act of speaking leads to significant increases in BP in normotensive as well as in hypertensive individuals. Furthermore the response to reading aloud as well as to subvocal reading is higher for hypertensives than for normotensives for SBP and MAP. In order to examine whether the higher BP response of the hypertensives should be ascribed to the cognitive activity associated with subvocal reading we also examined BP during the task that preceded subvocal reading, the pre-rest period. An analysis of variance on pre-rest BP measures with the post-rest BP measures as covariate, revealed a significant difference in BP response between normotensives and hypertensives during the pre-rest period.

The BP increase during rest in hypertensives might indicate a certain amount of perceived stress during our very simple low stress tasks. As Light (1981) pointed out, pre-task or pre-stress rest should sometimes be classified as a task or a stressor in itself rather than as a period of rest. This notion is supported by a study in which anticipatory stress prior to reading was investigated in normotensives (Penzien, Hursey, Kotses, & Beazel, 1982). A group who's anticipation of reading was coupled with expected evaluation of reading performance, showed larger HR increases than did a group that received an instruction that stressed interest of the researchers in readability of the material. Higher responses in SBP were observed in normotensives expecting to perform moderately difficult mathematical problems as compared to a group anticipating easy problems (Contrada, Wright, & Glass, 1984).

Although adults generally show greater BP responses and lower HR responses to laboratory stressors than children, there is no evidence of a linear relation of age and BP response in adults (Matthews & Stoney, 1988; Watkins & Eaker, 1986). The age difference between normotensives and hypertensives may, however, have added to the overall higher BP response of the hypertensives to the combined tasks. A possible influence of age on the BP response to speech has not been reported and cannot be concluded from this sample.

The magnitude of the BP response of our hypertensives with and without medication is not significantly different. Although various medication was used by our subjects, eight out of thirteen used beta-blockers. Now, we know that selective (atenolol) and nonselective (propranolol) beta-blockers decrease resting HR levels as well as HR reactivity (Frederikson, Danielssons, Engel, Frisk-Holmberg, Ström, & Sundin, 1985). Lower HR resting levels are clearly seen in our sample, but a lower HR reactivity was not found.

Regarding BP reactivity, our findings are in line with other reports. An unchanged pressor response was observed during a quiet conversation in subjects injected with oxprenolol. The latter subjects even showed a larger percentual increase in MAP as uninjected subjects, although the difference was not significant (Ulrych, 1969). It was also not reduced during a Structured Interview in hypertensive subjects using propranolol, although the Type A speech characteristic 'explosive speech' was apparently affected by this beta-blocker (Krantz, Contrada, Durel, Hill, Friedler, & Lazar, 1988). It appears that although beta-blockers may reduce BP levels, they do not influence the BP response to speech. An influence of beta-blockers on a BP response in hypertensives caused by anticipatory stress is also not likely to occur, given reports of a reduction of BP response in hypertensives through beta-blockers during dynamic and isometric exercise, but not during mental stress (Francois, Cahen, Graveit, & Estrade, 1984; Houben, Thien, Boo, Lemmens, Binkhorst, & van't Laar, 1983).

Although the nonsignificant Groups x Tasks interaction indicates that the magnitude of the BP response to speech in hypertensives is of equal magnitude as that in normotensives, hypertensives appear to reach their maximal response quicker than normotensives. Furthermore their BP is not progressively decreasing during the second subvocal reading period. This difference is indicated by the significant Groups x Periods interaction in DBP. One must bear in mind that our subjects were forced to use their voice for a continuous period of 1 minute, whereas a normal use of the voice in a conversation usually is of a shorter duration. In natural interactions hypertensives might show high BP responses more often than normotensives. Whether an increased number of BP responses plays a causal role in hypertension or is a consequence of it remains unclear (Shapiro, 1988).

Although the magnitude of the BP response to speech does not differ significantly between normotensives and hypertensives, the duration of the response after speech might differ. Other studies report that the BP response to mental arithmetic tends to persist longer in hypertensive individuals than in normotensive ones after cessation of the stimulus (Brod, Fencl, Hejl, & Jirka, 1959). This difference in response latency has important implications for investigations that employ continuous measures to assess the cardiovascular response to speech in a natural setting. Especially in categorizing these measures into speech and non-speech measures the time that elapses since the last speech activity should be taken into account. A categorization that relies solely on the presence or absence of speech neglects the persistence of the response. The latter might have been the case in an experiment that reported only a small change in the the R-wave to ear pulse interval (RPI) during naturally occurring speech in air traffic controllers (Henderson, Bakal, & Dunn, 1990).

Our study demonstrates again the strong influence of the simple act of vocalization on BP. By measuring BP continuously we could establish a significant increase in BP occurring within 20 seconds of uninterrupted noninteractive speech. A difference in response magnitude between normotensives and hypertensives, which was proclaimed in other studies, was not observed. Our findings point, however, towards a quicker DBP response in hypertensives. The BP response in hypertensives during a pre-rest period stresses the importance of the use of a post-rest period for the measurement of baseline BP values. The response to speech and to other aspects of any dyadic interaction apparently interact easily, but should be assessed separately through careful study.

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Topic-Involvement and Blood Pressure: The Differential Influence of Positive and Negative Affect During an Interview

Gérard Näring, Cees van der Staak, Hubert De Mey, and Cas Schaap

Blood pressure and heart rate of hypertensives and normotensives was continuously measured during discussions of several personal topics. Afterwards the subjects indicated to what extent they experienced each of a list of 24 affect related terms for each topic. Measures of general, negative, and positive topic-involvement were derived from these scores. Discussing topics with much negative affect was associated with rises in diastolic blood pressure in hypertensives. Discussing a topic with much positive affect was associated with a decrease in heart rate for both normotensives and hypertensives. It is concluded that the influence of involvement on BP is apparently dependent upon the negative or positive connotation of underlying content or affect.

In the late thirties, Alexander (1939) reported a positive correlation between emotional tension and rise in blood pressure (BP) in a hypertensive patient. The nature of the tension was identified as the inhibition of aggressive impulses. Other reports of case studies on hypertensives also demonstrated a profound influence of suppression of anger on BP using content analysis (Hambling, 1952). More recent research provides similar results comparing groups of normotensive and hypertensive individuals on self report scores measuring a tendency to control aggressive impulses (Cottington, Brock, House, & Hawthorne, 1985; McClelland, 1979). James and his colleagues studied the influence of negative affect as well as positive affect on BP in borderline hypertensives (James, Yee, Harshfield, Blank, & Pickering, 1986). These researchers linked BP measures taken in different situations to self-report measures of happiness, sadness, anger, and anxiety. An increase in degree of happiness was associated with a decrease in systolic BP (SBP), while an increase in anxiety was characterized by an increase in diastolic BP (DBP).

In contrast to these findings Innes, Millar, & Valentine (1959) did not detect a significant relation between observer ratings of the emotions of rage, anger, and fear with pressor responses in hypertensives and normotensives. Nor did they find a relation between the pressor response and ratings of emotional strength or increased repression. They suggested that the sheer novelty of a topic in a discussion might produce a pressor response and that the mechanism is thus nonspecific and alerting in nature. Quite similar results were also obtained in hypertensives (Hardyck, Singer & Harris, 1962). An estimation of the degree of emotional involvement enabled identification of pressor episodes with statistical accuracy, while ratings of specific affect did not show any relation with pressor responses.

Involvement was more specifically defined by Singer (1974) as "that central phenomenon which suggests a person is locking into, actually investing in an interaction, in its internal and external aspects. It includes features of attention, alerting, arousal, affect, activation, but refers to more than each of these" (p. 2) . A distinction is further made between involvement as a stable personality characteristic and as a relatively transient state. This definition stresses the transactional aspects. Other definitions stress engagement with oneself, self-involvement (Scherwitz, 1978) or with topics in a conversation, topic-involvement (Näring, de Mey, & Schaap, 1988).

Several studies indicate that global ratings of involvement as a personality characteristic can easily be made. Tennes and Kreye (1985) measured transactional involvement in school children by counting the number of positive social transactions at school. This measure correlated positively with cortisol excretion. Others judged the level of involvement during pretreatment consultation in sixty cancer patients. Involvement level, together with ratings of reality testing and degree of arousal, was predictive of psychosocial problems one month after the start of radiation therapy (Schmale et al., 1982-83). Another measure of transactional involvement, made by interviewers or blind raters on a 5-point scale, aided in correctly predicting the diagnosis in 83 to 94 % of women admitted for a breast biopsy (Wirsching, Stierlin, Hoffmann, Weber, & Wirsching, 1982). Finally, it was established that generally more highly involved workers have more variability in BP than less involved workers (Sparacino, Ronchi, Brenner, Kuhn, & Flesch, 1982). These researchers confirm that an accurate judgement of involvement is easily made, especially in situations that are stressful for the subject under study (Singer, 1974).

Judgements of short term changes in involvement level are more difficult to make. Measures of involvement of periods ranging from 4 to 20 min in length accurately predicted episodes of high, intermediate and low BP (Hardyck et al., 1962). Judgements of 1-min periods from an interview reached only moderate levels of reliability, but showed predictive value for BP measures taken 1 min later (Smyth, Sparacino, Hansell, & Call, 1980). Williams, Kimball, & Williard (1972) varied involvement experimentally and found higher DBP's in an interview in which there was relatively more interaction than in an interview dealing with the same content but having less interpersonal interaction.

Self-involvement has thus far been operationalized as a frequency count of the words "I", "me", and "mine" in a conversation. Measured this way it appears to covary with BP in Type A individuals (Scherwitz, Berton, Leventhal, 1978). It was also found to be a significant correlate of extent of disease in a sample of patients with clinical symptoms of coronary artery disease, when controlled for age, BP, cholesterol and Type A behavior (Scherwitz et al., 1983).

Attempts to vary topic-involvement systematically or to measure it are scarce. Although content is regarded as less important than interpersonal interaction in determining the DBP response to an interaction, content has a facilitating or hindering role (Williams, Kimball, & Williard, 1972) as was clearly demonstrated by Williams and McKegney (1965). They varied topics along the dimension: "personal nature of the content" by using a word association task, cards from the Thematic Apperception

Test, and a personal problem discussion. The personal nature of the topics was thus predetermined by the researchers, but in such a way that the structure of the interview as well as the degree of interaction necessarily changed as well.

As involvement with a topic sets boundaries on the amount of interactional involvement and interacts with the latter, a measure of both elements is needed. A method to measure the involvement of a person with a specific topic lacks however. Ratings like the intimacy value of questions and topics as used in studies on self-disclosure (Jourard, 1971) are not suitable for this purpose. As the unique individual meaning of an answer can only be assessed by a person himself, a self-report measure is required.

The Self-Confrontation Method by Hermans (1987) offers a frame to guide a personal discussion as well as a method to assess the individual affective aspects of the topics discussed. With the help of the interviewer the subject formulates important aspects of his life in so called valuations or value areas. These value areas, the topics discussed, are then, each separately, connected to a list of 24 affect terms by the person. The sum score of all affect terms pertaining to a value area constitutes a measure of involvement with that value area. In this method self-report measures of affect are obtained after the actual interaction, but they appear to be valid measures of the actual affect during the interaction (Gottman & Levenson, 1985).

Because a differential influence of positive and negative affect on BP is suggested by James et al. (1986), separate measures of positive and negative involvement will be included. The aim of the present experiment is to establish whether high topic-involvement covaries with high BP level during a discussion of that topic.

Method

Subjects

In this study 6 normotensive subjects, three men and three women, and 19 hypertensive subjects, ten men and nine women participated. Mean age of the normotensives and hypertensives was 22 and 38 respectively. Participants were recruited through advertisements placed in the university newspaper.

Apparatus

During the discussion BP and HR were measured on the finger every 2 sec with a Finapres. This instrument measures BP reliably and noninvasively with a fingercuff (Settels & Wesseling, 1985; Wesseling, Settels, & de Wit, 1986). The Finapres was linked to an Apple II^{e} computer that also controlled a video cassette recorder. A recording of the whole discussion was made to ensure exact matching of BP measures and topics.

A Dinamap, an automatic device using an armcuff, measured baseline values of BP and HR at the start of the session. These additional BP measures were taken because BP measured on a finger positioned below heart level overestimate BP measured on the arm.

Procedure

Four students, all trained in using the Self-Confrontation Method, served as experimenters. Subjects were informed about the procedure to be followed, were allowed to ask questions and then signed a declaration of informed consent. The Dinamap was attached to the left arm, the cuff of the Finapress to the ringfinger of the right hand. The right arm was loosely attached to the elbow-rest of the chair, to prevent the subject from moving too much. The subject was then asked to relax and was told that baseline measures would be taken. Both instruments were started and three arm measures were taken with the Dinamap, at intervals of 2 min. The Dinamap was then removed. As it takes several minutes before the Finapres measures reliably, finger BP measurements are only used from the next elements of the experiment. The subject then received a printed text and was asked to read alternately subvocally and aloud for 4 min. Data from this assessment of BP during speech will not be reported here. During a rest period of 1 min a BP baseline was then obtained with the Finapres. Finally, the experimenter invited the subject to:

> reflect on his or her life situation in such a way that he or she was as free as possible to mention those concerns that are relevant from the perspective of the present situation. The person is encouraged to phrase the valuations in his or her own terms so that the formulation is as much as possible in agreement with the intended experience. (Hermans, 1987, p. 13).

There was no requirement that each question should result in an answer. The interview started with the first set of questions centering around the past: "Was there something in your past that has been of major importance and significance for your life and that still plays an important part today ?" or " Was there in the past, a person, an experience, or a circumstance that greatly influenced your life and still appreciably affects your present existence ?". Other sets of questions centered around Present, Future, Activities, Enjoy, Thinking, Reject, and Unity. The experimenter aided the subject in formulating a value area in one sentence and wrote this sentence on a card. Continuous BP measures were collected in the period between question and formulation, with a maximum of 5 min. After the interview the cuff was removed and the person was instructed to indicate on a list of 24 affect terms to what extent he or she experienced each affect while concentrating on a specific value area (0 = not at all, 1 = a little bit, 2 = to some extent, 3 = rather much, 4 = much, and 5 = very much). The list of affect terms is given in Table 1. The subject was left alone to perform the scoring of affect.

Table 1
Affect Terms used in the Self-Confrontation Method

Positive	Negative
Joy	Powerlessness
Self-esteem	Anxiety
Happiness	Worry
Enjoyment	Stress
Love	Self-alienation
Solidarity	Unhappiness
Inner warmth	Guilt
Trust	Loneliness
Security	Inferiority
Energy	Anger
Inner calm	Despondency
Freedom	Disappointment

The general involvement score of a value area was calculated as the sum of the scores on all the 24 affect terms on that area. Separate measures of positive and negative involvement are obtained by calculating the sum of score on the positive or negative affect terms. Scale analyses were performed and although the reliability of general involvement was found to be high (Cronbach's alpha =.84), some affect terms correlated only .15 with the total score. The subscale of positive affect terms reached an alpha of .94; the scale of negative affect terms .87.

Design

As some subjects formulated only six value areas, the first six areas of each person were used in the analysis. For each value area the mean was calculated of the continuous SBP, DBP, mean arterial BP, and HR measures. For each subject rank orderings of the six value areas were made on scores of general, positive, and negative involvement. A multivariate analysis of covariance, with a between-subjects Factor Diagnosis and repeated measures on a Factor Involvement, was applied to the physiological measures of the area with the highest and lowest involvement in a rank ordering. The mean of the last five measures of the rest period after the reading task was used as a covariate.

Results

The average of the second and third BP measurement before the interview (Dinamap) is used to describe BP characteristics of the subjects. Mean SBP / DBP value for normotensives was 122 / 68 mm Hg, for hypertensives 144 / 92 mm Hg.

Analyses of covariance were performed on the mean of the BP and HR measurements during the formulation of the value areas with, for each individual separately, the lowest and highest involvement scores. The results of these analyses for general, negative, and positive involvement separately are shown in Table 2, cell means are shown in Table 3.

The analysis of covariance showed no effect of general involvement on BP as indicated by a nonsignificant Factor Involvement and a nonsignificant interaction of

Table 2

Analyses of Covariance of Blood Pressure and Heart Rate of Value Areas with Individual Extremes of Topic-Involvement

	Systolic blood pressure		Diastolic blood pressure		Mean arterial pressure		Heart rate	
	F^a	p	F	p	F	p	F	p
General Involvement								
Diagnosis	8.11	.00**	3.31	.08	4.68	.04*	5.00	.04*
Involvement	.67	.42	.43	.52	.38	.54	8.25	.009**
Diagnosis x Involvement	.04	.84	.04	.84	.02	.89	13.98	.001**
Positive Involvement								
Diagnosis	4.70	.04*	2.78	.11	3.65	.07	5.48	.03*
Involvement	.88	.36	.28	.60	.58	.45	13.06	.001**
Diagnosis x Involvement	.01	.91	.01	.93	.00	.94	3.77	.06
Negative Involvement								
Diagnosis	5.18	.03*	2.86	.10	3.84	.06	5.74	.03*
Involvement	.15	.70	.68	.41	.23	.63	.88	.36
Diagnosis x Involvement	.41	.52	4.67	.04*	3.77	.06	.38	.54

Note. a post-rest level of a reading task was entered as covariate.

[a] F values have 1, 22 d.f. (Diagnosis) or 1, 23 d.f.(Involvement and Diagnosis x Involvement)

* $p \leq .05$. ** $p < .01$

Table 3
Mean Blood Pressure and Heart Rate Levels of Normotensives and Hypertensives during Individual-Extreme Levels of Topic-Involvement

	Involvement level	Group: Normotensives	Hypertensives
Systolic blood pressure			
	Positive		
	Low	170.8	206.1
	High	168.1	204.0
	Negative		
	Low	169.0	203.2
	High	166.5	203.9
Diastolic blood pressure			
	Positive		
	Low	99.5	117.0
	High	99.0	116.4
	Negative		
	Low	100.9	115.9
	High	97.2	117.7
Heart rate			
	Positive		
	Low	79.8	79.5
	High	74.6	77.9
	Negative		
	Low	77.0	78.2
	High	77.4	79.6

Involvement and Diagnosis. Similarly, no significant results were obtained for BP on the extremes of positive involvement.

Negative involvement, however, is differently associated with BP level in hypertensives than in normotensives as indicated by a significant Involvement x Diagnosis interaction. In hypertensives, DBP and mean arterial BP are both 2.2 mm Hg higher during the formulation of the topic with the highest negative involvement compared to the area with the lowest negative involvement. In normotensives an opposite pattern is seen, as DBP and MAP are about 4 mm Hg lower in the area with the highest negative involvement.

HR is lower during a discussion on a topic with much positive involvement than during a discussion on a topic with little positive involvement. In a comparison on general involvement HR is also lower during the topic with the highest involvement score than during the topic with the low involvement score.

The Factor Diagnosis is always significant for SBP and HR. For MAP it is marginally significant, while DBP is not significantly different between the two groups. BP and HR response of the hypertensives to this personal discussion was thus higher than that of normotensives.

Discussion

During a discussion on topics with much negative affect, hypertensives demonstrate a higher DBP than during a discussion of topics with less negative affect. In normotensives an increase in negative affect is associated with a lowering of DBP. Discussing topics with varying degrees of general or positive affect is not accompanied by significant changes in BP. A slow HR is consistently observed during segments of the interview with relatively more general or positive affect. Because the general involvement score is highly correlated with positive involvement ($r = .79$; $p < .001$; $N = 150$) and only moderately with negative involvement ($r = .37$; $p < .001$; $N = 150$) analyses on general and positive topic-involvement parallel each other.

The two specific measures of topic-involvement result in different relations of topic-involvement and BP. As the general topic-involvement measure is insensitive to some changes in BP and HR, the use of separate measures, based on the positive or the negative connotation of the constituting affect, is warranted.

Our findings show similarities with findings on the influence of specific positive and negative affect on BP. Firstly, a difference in DBP levels during different affect was also reported by others. In normotensives that were asked to recreate vividly a situation in which they felt anger, fear, happiness, sadness, and relaxation, SBP did not differentiate between conditions. In DBP anger produced large increases in DBP, while fear or sadness did not. In borderline hypertensives an increase in DBP was observed during increased anxiety (James et al, 1986). Secondly, the influence of positive affect on BP is apparently beneficial. In normotensives, SBP and DBP were almost similar during happiness and during a control condition (Schwartz, Weinberger, & Singer, 1981), whereas in borderline hypertensives a decrease in SBP was associated with self-report measures of happiness (James et al, 1986). In our subjects heart rate was lower during the formulation of a value area with much positive involvement. The influence of relaxation on BP is often studied but there is a gap when it concerns experiments on the influence of positive affect on BP.

The similarities in BP response during relaxation and positive affect are paralled in the experiences of the subjects during both states. The self-report measures of the intensity of feelings during the recreation of a happy scene were equal to those of a state of relaxation, and imagining a relaxing situation was characterized by feelings of happiness (Schwartz et al., 1981). This similarity in self-reports of the experience of happiness and of relaxation points to a possible elicitation of the relaxation response during both affective states, which explains a lowered BP and HR during both states (Stainbrook, Hoffman, & Benson, 1983).

The results of this study and of experiments on specific affect do not support a linear relation between involvement and BP. More involvement, regardless of content or affect, is not associated with an increase in blood pressure. More involvement with a positive connotation is even more likely to lower BP, than to raise BP.

Similar specific measures are probably also needed in the study of self-monitoring. Self-monitoring points to the regulation and control of nonverbal and expressive behavior. The relation between self-monitoring scores and BP levels in various subgroups is not clear (Sparacino, Ronchi, Bigley, Flesch, & Kuhn, 1983). A differentiation between self-monitoring of positive and negative affect may be useful.

The differences in BP that were found in this experiment are small but comparable to those in the study of specific emotions (Schwartz et al., 1981). The correlations between the different measures of topic-involvement show that the subjects' topics were probably not dominated by a single affect. A high level of negative topic-involvement is likely to be associated with a certain level of positive involvement and vice versa. Furthermore, the questions that the subjects answered were very intimate and probably caused a high level of topic- and transactional involvement throughout the whole interview. One could obtain more variation in involvement through the inclusion of questions that elicit less involvement. One could also exclude transactional involvement by measuring BP during the scoring of affect terms and not during the interview itself.

In line with what we expected, a higher involvement with negative affect leads to a higher BP, but only in hypertensives. This supports the view that hypertensives have difficulties with the management and expression of negative affect, which in turn acts as a stressor.

Our measures of topic-involvement enable an intra-individual assessment of a range of subject-bound topics covering the strength and/or frequency of a broad range of affect terms. The relative balance of the influence of involvement with positive and negative affect on BP has yet to be determined, the distinct influence of positive affect appears clear.

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The Influence of Interactional Feedback on the Blood Pressure of Hypertensives *

Gérard Näring, Hubert De Mey, and Cas Schaap #

In this experiment we assessed the effectiveness of a procedure in which instructions and feedback on behavior in a dyadic interaction were given in lowering blood pressure (BP) level of hypertensive patients. Participating subjects were not on antihypertensive medication and BP was measured daily at home and at our laboratory. In a cross-over design the procedure was compared with a control procedure consisting of relaxation and BP biofeedback. A statistically significant difference in BP emerged between the sequences in which the procedures were presented. No significant differences or interactions between the procedures were detected. The interactional procedure followed by the control procedure was successful in lowering BP, while the reverse sequence was not. The role of a favorable patient-practitioner relationship in determining results in BP of the procedures is discussed. The group that received the successful sequence exhibited higher BP and heart rate measures at our laboratory than at home, which may be indicative of a high level of anxiety. It is argued that a positive effect could be limited to anxious patients.

High blood pressure (BP) is one of the most important risk factors for the development of cardiovascular diseases and contributes substantially to heart insufficiency, cerebrovascular accidents and kidney diseases (Kaplan & Lieberman, 1986). In the etiology and treatment of high BP, a distinction is made between primary or essential hypertension (EHT) and secondary hypertension. In the case of secondary hypertension an organic cause is known and a causal treatment is possible. However, for over 95% of the patients with high BP the cause is unknown and a symptomatic therapy is decided upon. By way of changes in life style and/or medication, the physician attempts to decrease and control the BP. At a diastolic blood pressure (DBP) of 105 mm Hg or more the use of antihypertensive medication is advised (Fodor, 1985).

The antihypertensive medication has considerable side effects, amongst others, impotence. Another problem is that EHT is not cured by medication. Patients have to take medication in principle during their whole life or, in any case, remain under the control of the physician. The search for effective psychological intervention strategies that help to normalize BP levels is therefore of the utmost importance.

To date effective psychological treatment consists mostly of biofeedback, relaxation, or the combination of these two interventions (Engel, Glasgow, & Gaarder, 1983). In order to obtain larger BP reductions, a combination of biofeedback or

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relaxation with other interventions is suggested (Wadden, Luborsky, Greer, & Crits-Cristoph, 1984). An example of such a combined intervention is the monitoring of BP on a minute-by-minute basis during psychotherapy sessions (Lynch, Thomas, Paskewitz, Malinow, & Long, 1982). The latter study drew attention to the influence of human interaction on BP.

Biofeedback and relaxation techniques typically emphasize the acquisition of a skill to reduce BP levels while being alone. We spend, however, most of our life interacting with others, which in turn influences our BP. In a recently published review (Näring, De Mey, & Schaap, 1988) we have listed the variables in dyadic interactions that play a role in determining BP levels. Among them are the role of the content of a conversation, the emotions of anger and anxiety, transactional involvement, and the act of speaking itself. Relaxation and biofeedback could be more effective in lowering BP level if they are focused on interactional variables, preferably based upon a diagnosis of individual pressor stimuli in interaction (Schwartz, Shapiro, Redmond, Ferguson, Ragland, & Weiss, 1979).

As a precursor to such a combined treatment, we designed a training procedure and assessed its effectiveness in lowering BP at home and in the laboratory. The aim of the training is to teach patients to reduce excessive reactions of BP during interaction with the aid of biofeedback. In addition to visual feedback by use of a red and green light, the trainer gives the patient feedback on specific behaviors that raise BP levels. Part of this information is gathered on the basis of coupling a continuous BP measurement device (called Finapres) to a video recording of the interaction between patient and trainer.

The training procedure uses biofeedback as a resource and teaches subjects to relax during an interaction. As biofeedback and relaxation practice are the two components of a treatment program that is commonly used to lower BP levels (Goldstein, Shapiro, & Thananopavaran, 1984; Engel et al. 1983), an effect of the training procedure on BP could be ascribed to the effect of these two elements alone. A surplus value of the training procedure in comparison with the common combination of biofeedback and relaxation should thus be demonstrated. We therefore compared the training procedure with a control procedure, consisting of biofeedback and relaxation practice. In a cross-over design all patients received both procedures.

Method

Subjects

A newspaper advertisement offered a new treatment procedure free of charge to patients who were diagnosed as having essential hypertension. The following inclusion criteria were used: (1) having essential hypertension for at least 3 months, (2) age between 25 and 50 years, (3) either taking antihypertensive medication or, when taking no medication, a DBP > 95 mm Hg or a systolic BP (SBP) > 160 mm Hg when assessed at our laboratory, and (4) permission of the personal physician to stop taking medication during the experiment. Exclusion criteria were: (1) use of other than anti-hypertensive medication, (2) other cardiovascular problems, (3) severe psychopathology as indicated by the Symptom Check List (SCL-90; Arrindell & Ettema, 1986), and (4) unreliable measures from the Finapres, mostly due to low finger temperature.

Of the 27 persons that went through the intake procedure 16 passed the criteria. These 12 men and 4 women were randomly assigned to one of the two conditions. After the 3 week baseline period one man decided not to participate because his BP had been within the normal range throughout the whole period. Another man dropped out after the first 3 weeks of training because his BP had hardly risen since he had not taken ß-blockers. The mean age of both groups, 7 subjects in each condition, was 43 years and did not differ significantly, $F(1, 12) = .06$, $p = .82$. Psychoneuroticisme scores of the SCL-90 were 1.55 in the sequence Control-Interactional (C-I) and 1.46 in the sequence Interactional-Control (I-C), respectively, and did not differ, $F(1, 12) = .28$, $p = .61$. There were also no differences in any of the subscales of the SCL-90.

At study completion, participants were questioned regarding changes in lifestyle, including smoking, weight change, and diet. No significant changes were reported, nor was weight change noticed by the interviewer.

Two female interns and one male psychologist each trained an equal amount of patients in the two conditions.

Apparatus

BP Instruments. Before and during the procedure, BP was measured daily at home by the patient with an automatic oscillometric device. These devices perform measurements completely automatic and provide prints of SBP, DBP, heart rate (HR) and time of the measurement. In our laboratory, BP and HR were measured with a Dinamap at intake, at the start of each session in a baseline procedure, and at follow-up. Follow-up took place 2 to 3 months after termination of the training. A Finapres, was used to measure BP noninvasively every 2 sec during baseline, during relaxation practice and biofeedback in the control procedure, and during all but one of the sessions of the training procedure.

Feedback system. Centered around the Finapres, a system and a procedure were developed in which visual biofeedback was given. This system contains a video cassette recorder (VCR), a TV set, a Finapres, and a red and green light, all linked to a microcomputer. A computer program continuously calculated the difference between two consecutive SBP measurements and kept trace of the number of rises and falls in a sequence of 12 measurements. When the number of rises exceeded six the red bulb was lit for at least 2 seconds. A green bulb similarly indicated more than six falls in a sequence. The lights were placed on a table in front of the subject.

Questionnaire. All subjects completed the Symptom Check List (SCL-90; Arrindell & Ettema, 1986) at intake and at the end of the training. This questionnaire was used to assess an effect of the training procedures on psychological complaints.

Procedure

Baseline procedure. In consultation with their physician, a wash-out period of 3 weeks for patients on antihypertensive medication was used. Directly after intake, all subjects received a BP measuring device. Subjects were instructed to monitor their BP *at home* twice a day (three measurements each time, spaced 2 min apart) during 3 weeks until the sessions started. During the 12 weeks of the procedures they continued measuring their BP. The 3-week baseline was included because BP measures taken at home initially tend to decrease (Laughlin, Fisher, & Sherrard, 1979).

Interactional Feedback Procedure (I). This procedure (I) consisted of:

First Session: Self-Confrontation Method (Hermans, 1987). Establishment of the impact of a range of personal topics on BP was done, while biofeedback was given. The two topics with highest absolute systolic BP levels were selected to be used for further discussions.

Second Session: BP biofeedback during interaction. Feedback was given while one of the topics selected in Session 1 was discussed. The discussion was videotaped to gather material for a later session.

Third and Fourth Session: Lowering speech rate and decreasing speech volume. All subjects, most of them exhibiting a high speech rate, received instructions to lower this rate and decrease excessive speech volume. Subjects practiced in a discussion on the personal topic, second in rank ordering of mean absolute systolic BP level. In the fourth Session the topic to be discussed was: "What caused and/or maintains your hypertension in your own opinion ?" During the discussion biofeedback was given. The biofeedback enabled subject and experimenter to pay attention to speech behavior, specific sub-topics, and specific emotions causing BP increases. In the one case where the speech rate of a client was extremely low, no specific instructions were given, except to pay attention to the feedback lights. These discussions were also videotaped.

Fifth Session: Learning the LSV formula: Listen, Summarize, Validate (Gottman, Notarius, Gonso, & Markman, 1976). We introduced this session on listening skills for two reasons. Firstly, to aid people to relax while interacting as it forces them to listen before responding. Thus, while the techniques of Sessions 3 and 4 help the subjects to relax while speaking, this session additionally helps them to relax while listening. A second reason for introducing this formula is to provide subjects with a tool to handle interpersonal conflicts.

Sixth Session: Reviewing interactional feedback. From Session 2 onwards, video recordings were made of the interactions of trainer and client, while BP was recorded simultaneously. With the aid of a computer program, segments of the recording were selected in which BP increased. The program calculated difference scores of consecutive BP measures and counted the number of positive difference scores in eleven consecutive difference scores. A segment was called a "rise" when at least seven positive difference scores were present, only occasionally this criterion had to be adjusted. The VCR received instructions from the computer via a remote control and displayed the segments of the interaction in which BP rose. These segments were scanned by the first author and the trainer until there was agreement upon the presence of high speech rate, loud speech volume, particular recurrent theme's, and recurrent affects. During the session most of the segments were shown to the client with the prepared comments on BP raising behavior given by the trainer.

Control Procedure (C). The control procedure consisted of 6 sessions that had the same format. All sessions started with relaxation (15 min), followed by biofeedback (20 min). Subjects practiced self-suggestive relaxation (Grol & Orlemans, 1979) in our laboratory. Moreover, they received an audiocassette with a recording of the first session and were instructed to practice once every day at home. After three sessions, they were encouraged to try and practice without the tape. In a later stage attention was paid to generalization, mostly to the worksite.

For the biofeedback procedure, the subjects sat in a chair in front of a table on which a red and a green lamp were placed. The subjects were instructed to try and keep the green light on as long as possible and were then left alone. Feedback was given according to the same criterion that was used to select segments from the interaction. In the first four sessions, SBP was monitored. In the last two sessions DBP was monitored and displayed graphically on a TV set.

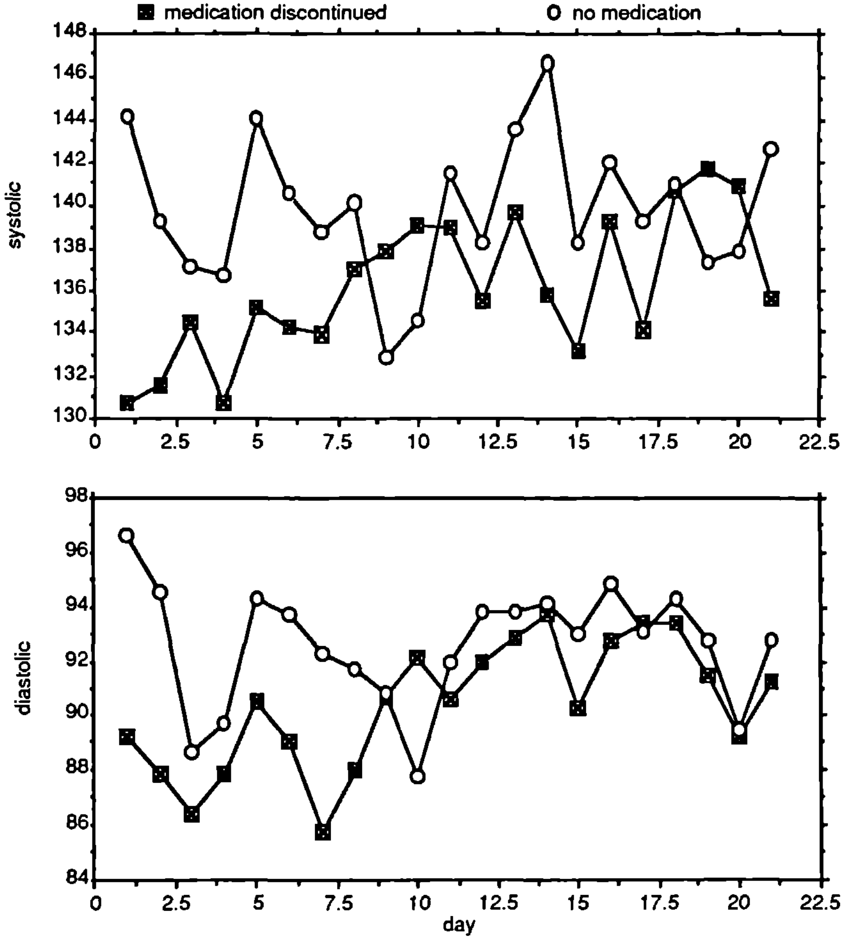
Design. A total of 14 patients were included in this study. Seven subjects started with the interaction feedback procedure, seven others with the control procedure. Sessions were scheduled once every week. After 6 weeks, subjects received the second procedure. A schematic representation is depicted in Figure 1.

Figure 1.
Content of the Sessions of the Two Procedures.

Session Number					
1	2	3	4	5	6
Control Procedure					
Relaxation+ Biofeedback	Relaxation+ Biofeedback	Relaxation+ Biofeedback	Relaxation+ Biofeedback	Relaxation+ Biofeedback	Relaxation+ Biofeedback
Interactional Feedback Procedure					
Biofeedback on Self-Confrontation Method	Biofeedback discussing topic with highest SBP	Biofeedback while lowering speech rate	Biofeedback while lowering speech rate	Listen Summarize Validate formula	Interactional Feedback with video segments

Method of analysis. BP measured at home during baseline was analyzed with a repeated measures ANOVA. BP measured at home and at the laboratory during the procedures was analyzed with a univariate repeated measures analysis of covariance (ANCOVA). A univariate approach was chosen because the sample sizes were almost equal to the number of repeated measures (Vasey & Thayer, 1987). Number of degrees of freedom and*F* ratios were corrected with Greenhouse-Geisser epsilon (e) when the assumption of sphericity was violated. The scores of the SCL-90 at intake and at the end of the training were compared using a two-tailed T-test. For statistical significance the .05 level was adopted.

Figure 2. Blood pressure during self-monitoring at home prior to procedures.



Results

BP monitoring at home. BP initially rose in patients that discontinued the use of medication as is shown in Figure 2. Those who did not use medication, initially showed large decreases in BP, but stabilized on a somewhat higher level in the 3^d baseline week. This initial fall in BP is probably due to a feedback mechanism. By daily monitoring their BP, people understandably become aware of the differential influence of work, sleep, sports and food on BP and may change some life habits (Laughlin et al., 1979). Mean SBP / DBP during the last 7 days was 144.4 / 95.9 in the sequence C-I and 136.5 / 90.5 in the sequence I-C. Repeated measures ANOVA's indicated that SBP as well as DBP were sufficiently stable during these days, $F(6, 78) = 1.37$, $\epsilon = .51$, $p > .25$ and $F(6, 78) = 1.92$, $\epsilon = .53$, $p > .10$ respectively. The mean of these BP measures was taken as a covariate in analyses on home BP measures.

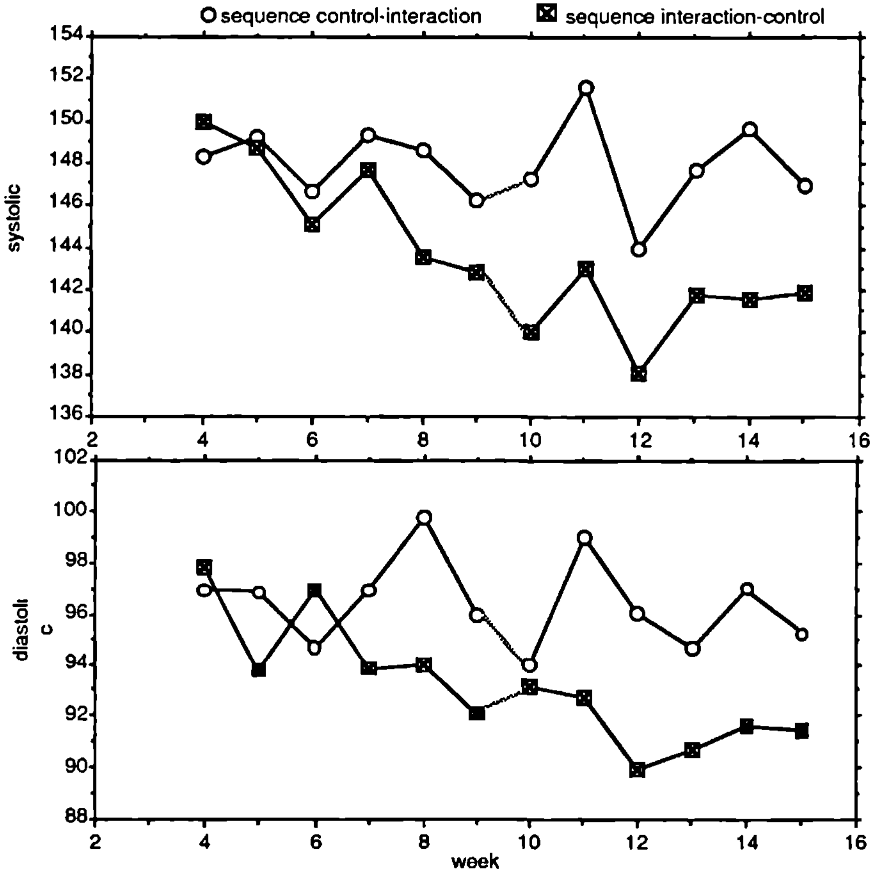
BP at start of the first procedure. The two groups were equal in BP level when assessed at our laboratory. Mean SBP was 148.3 in the sequence C-I and 149.9 in the sequence I-C, $F(1, 12) = .04$, $p = .84$. Mean DBP was 96.9 in the sequence C-I and 97.8 in sequence I-C, $F(1, 12) = .02$, $p = .89$.

Mean BP values at home in the 3^d week of monitoring are given above. Groups do not differ in SBP, $F(1, 12) = 2.33$, $p = .15$, or in DBP, $F(1, 12) = 2.33$, $p = .15$. Subjects in the I-C sequence demonstrate lower BP values at home than at the laboratory.

BP at laboratory. BP measured during baseline at the start of each session was analyzed with a repeated measures analysis of covariance (ANCOVA). Measures taken at the first session of each procedure were used as a covariate. A nonsignificant factor Procedure indicates that the effect of the two procedures on DBP or SBP at the laboratory did not differ. The nonsignificant interaction Sequence x Procedure shows that the effect of the procedures was also not affected by the previous procedure.

The factor Sequence was significant for DBP, $F(1, 11) = 8.28$, $p = .02$, which points to a larger effect of the sequence I-C in comparison to the sequence C-I, for SBP this effect was not significant, $F(1, 11) = .12$, $p = .74$. As shown in Figure 3 there was a downward trend during the I procedure when this procedure was given first. This trend continued during to the first 3 weeks of the C procedure. It is difficult to say whether this is a carry-over effect of the first procedure or a sensitization by the first procedure to the second one. Interaction effects were not statistically significant for SBP or DBP.

Figure 3. Blood pressure at laboratory during the two sequences of the two procedures



BP at home. The mean of the first week of a procedure was used as a covariate in ANCOVA's on the means of the remaining 5 weeks of each procedure. The factor Sequence was marginally significant for SBP, $F(1, 11) = 4.14$, $p = .07$, but not for DBP, $F(1, 11) = 2.68$, $p = .13$. Neither the factor Procedure, nor the interaction Procedure x Sequence approached significance for SBP or DBP. To obtain a more powerful analysis, a more parsimonious model was used by removing the factor Procedure from analysis. The subsequent analysis with the first week of the first procedure as a covariate, revealed again a significant difference between the effect of the sequence I-C and that of the sequence C-I in both SBP and DBP, $F(1, 11) = 6.62$, $p = .03$ and $F(1, 11) = 5.68$, $p = .04$ respectively. Whereas the BP of the subjects in the sequence C-I is hardly influenced by the two procedures, the sequence I-C shows a clear effect as can be seen in Figure 4.

BP at follow-up. To evaluate lasting effects of the procedures on BP, subjects returned to our laboratory 3 months after the last session. Mean DBP and SBP values in the two groups at follow-up together with values at start and at end of the procedures are shown in Table 1. In a repeated measures ANCOVA, laboratory BP measures at follow-up were compared with measures of the last session, with BP at the start of the first procedure as a covariate. In both groups a significant rise was seen after termination of the programs in DBP, $F(1, 12) = 7.76$, $p = .02$, as well as SBP, $F(1, 12) = 5.86$, $p = .03$. Subjects in the two conditions differed marginally in SBP at the end of the programs and at follow-up, $F(1, 12) = 3.93$, $p = .07$. The significant factor Time in SBP as well as DBP indicates that the subjects demonstrated a rise in BP during the 3 months after termination of the procedures.

Figure 4. Blood pressure at home during the two sequences of the two procedure

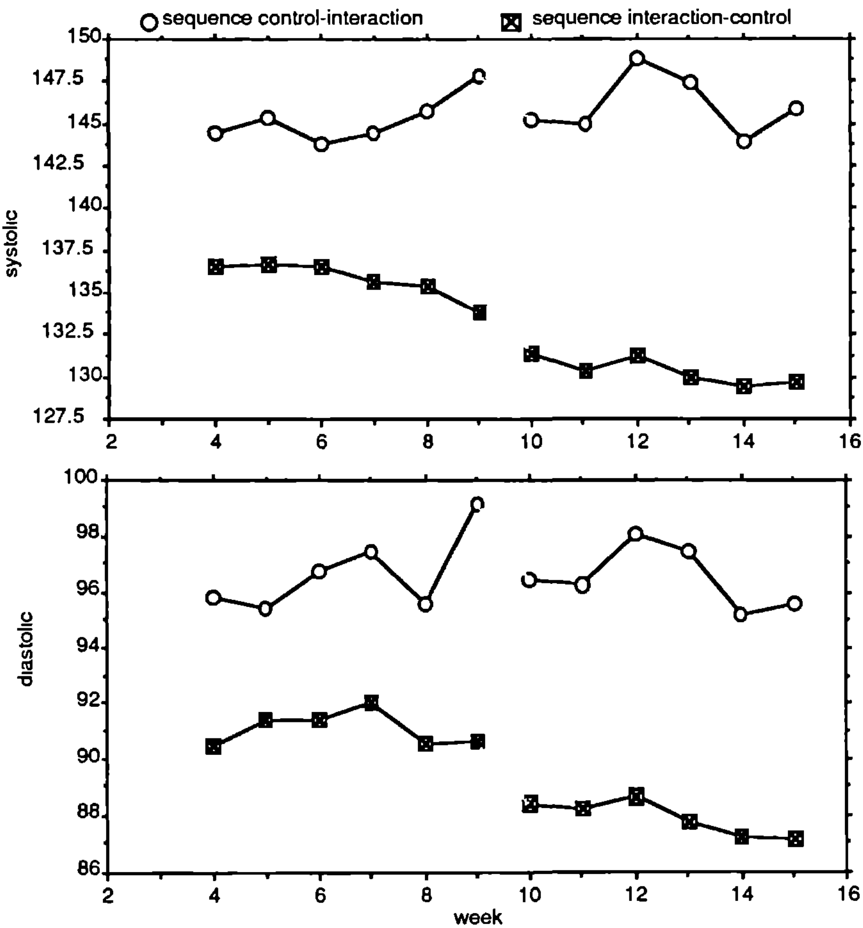


Table 1
Mean Blood Pressure in Conditions at Start and End of Program and at Follow-up

	Start	End	Follow-up
Systolic Blood Pressure	*M* *Sd*	*M* *Sd*	*M* *Sd*
C-I	148.3(13.6)	147.0(14.9)	154.6(16.4)
I-C	149.9(15.6)	141.9(11.2)	146.1(12.3)
Diastolic Blood Pressure			
C-I	96.9(10.8)	95.2(10.4)	100.4(10.0)
I-C	97.8(11.6)	91.4 (8.7)	96.5 (5.8)

Note Laboratory measures are reported

SCL-90. The Total Psychoneuroticism Scores of the SCL-90 at intake and after completion of the second procedure were compared using a T-test. The total score was significantly lowered from 1.50 to 1.31 after the procedure, $T(13) = 2.19$, $p = .04$. Subsequent T-tests on subscales revealed a significant reduction in anxiety score from 1.60 to 1.30, $T(13) = 2.97$, $p = .01$, and in somatization score from 1.73 to 1.31, $T(13) = 5.21$, $p < .01$.

Discussion

We studied the BP of hypertensives during a procedure in which feedback on behavior in dyadic interaction was given and during a control procedure consisting of relaxation and BP biofeedback. Significant differences in BP were neither detected between procedures nor in interactions between procedures and sequences. There was, however, a statistically significant difference between the sequences in which the procedures were presented. This effect was seen in the weekly DBP measures taken at our laboratory and in the daily DBP and SBP measures collected at home. The sequence "interactional procedure followed by control procedure" was more successful than the reverse sequence.

While the BP of the patients in the success-sequence was lowered during the two procedures, BP of the patients in the non-success-sequence hardly changed during any of the two. The first procedure apparently determined the effect of both procedures on BP. This finding may be illustrative of the larger effect of treatment studies with a predominantly clinical focus compared to those with a predominantly experimental focus as reported by Lynch and his colleagues (1982). These authors mentioned a positive treatment expectancy and a favorable patient-practitioner relationship as a possible explanation for the superiority of clinically oriented studies. Our control procedure comprised little patient-trainer interaction and may have suffered from its definite experimental outlook, as exemplified by the continuous adaptation of cuff pressure during relaxation. During an interaction with the trainer the same intrusive experimental elements may have gone unnoticed. If subjects starting in the control procedure indeed expected little positive result of this procedure, this may have influenced their expectancy of the results of the second procedure negatively.

All subjects in this study discontinued medication several weeks before the start of the program. Reviews of the literature indicate that the majority of BP treatment studies investigated subjects on antihypertensive drugs (Johnston, 1985; Julius & Cottier, 1983; Seer, 1979; Wadden et al., 1984). Treatment consisting of relaxation, biofeedback, or a combination of them, is certainly a useful adjunct to pharmacological therapy, but is not always viewed as an alternative (Seer, 1979). Our follow-up results demonstrate that a treatment based upon the successful sequence would probably require continued practice.

There are differences in some characteristics of our two groups that deserve attention. The group that received the procedures in the I-C sequence showed higher SBP values at the laboratory than at home. This discrepancy between BP measured at home and at our laboratory is probably a patient characteristic that forms an important determinant of the result of a behavioral intervention. What was intended as an adjunct to the procedure and a way to measure BP outside the laboratory, appeared to be an instrument that revealed that our groups, although properly matched on laboratory BP values, did differ substantially on BP measured at home. Additional analyses on the routinely collected HR measures were performed to shed more light on this influence of location on BP values. HR measured at our laboratory was slightly different between groups, 67.4 bpm in the C-I sequence and 76.6 bpm in the I-C sequence, $F(1, 12) = 3.52$, $p = .085$. HR at home was 67.1 bpm for the C-I sequence and 69.3 bpm in the I-C sequence. Subjects in the C-I sequence show different SPB and HR values at the laboratory than at home.

That this difference in BP characteristics may have influenced our results is suggested by a study that reported high heart rates together with high anxiety scores and low peripheral temperature as indicative of success in biofeedback-assisted relaxation (McGrady & Higgins, 1989). High anxiety scores are predictors of success in treatments that comprise biofeedback and/or relaxation, and the effect of such therapies is larger when initial BP level is higher (Jacob, Kraemer, & Agras, 1977; Kaufmann et al., 1988).

A prerequisite for a high anxiety level to be a predictor of success in BP programs that are based on biofeedback or relaxation is that the anxiety is not accompanied by serious psychological distress. A high anxiety score combined with high scores on the subscales Interpersonal Sensitivity, and Hostility of the SCL-90-R, higher SBP values, and higher HR during a mental task, was found to predict resistance to a biofeedback / relaxation training (Nakagawa-Kogan, Garber, Jarrett, & Hendershot, 1988). Although hypertensives generally appear to have higher scores on the SCL-90 than normotensives (Coelho, Hughes, Fernandes da Fonseca, & Bond, 1989), a very high level of current or recent psychological distress is a contra-indicator for medical or behavioral control of hypertension. Studies in which this relation was found, assessed psychological distress with a 4-item questionnaire (Brody, 1980) and with a combination of the SCL-90 and a count of Life Events (Egan, Nakagawa-Kogan, Garber, & Jarret, 1983). In our study, of the subjects that received the C-I sequence, six out of seven had "above average" scores on the SCL-90 or higher while in the other sequence only three out of seven reached this level. This may have contributed to the difference in response to our interventions.

Our interactional procedure is based on the assumption that people can readily learn to recognize when their BP rises and subsequently can learn to prevent such a rise. The emphasis of the interactional procedure was mainly on the directions for speech behavior, topics, and emotions, while the presence of BP rises was externally monitored by a computer. More emphasis on how to recognize high BP through internal and environmental cues may make the procedure more effective. Others found a combination of individually assessed environmental cues, like time pressure or evaluation by others, and internal cues, as bodily sensations and moods, to be very helpful in BP monitoring by normotensives (Barr, Pennebaker, & Watson, 1988).

Practicing biofeedback and relaxation during an interaction may be a fruitful approach towards a more effective behavioral treatment of hypertension. In the present experiment we used an elaborate equipmental technique for the individual assessment of specific behaviors that raise BP, but the effectiveness of an adapted procedure with only BP biofeedback equipment should be investigated. A universal conclusion might be that, whatever the goal of a session of a treatment is, the therapist or trainer should always pay careful attention to the effect of his or her ongoing interaction with the patient.

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Discussion

The series of experiments conducted in this study were designed to identify and understand variables that determine blood pressure (BP) changes during verbal interaction. Of specific interest were interactional variables that account for BP rises in hypertensives and have a differential influence on the BP of normotensives and hypertensives. Such variables are important for understanding the development of essential hypertension (EHT) and in designing programs for the behavioral treatment of EHT.

In Chapter 2, the literature on variables related to BP during verbal interaction were reviewed and classified as content and emotion, interpersonal variables, speech-related variables, and individual-difference variables. A major limitation of previous studies appeared to be that BP was primarily measured with intervals of 1 minute or longer. In regard to physiological measurements, new instruments, such as the Finapres used in our experiments, make it easier to measure BP continuously. In contrast, the discovery, conceptualization, and operationalization of psychological variables that match BP changes at a microscopical level are still in a beginning phase.

Implications of the results

Involvement

Ewart, Burnett, and Taylor (1983) found an association between BP reactivity and distinct categories of interpersonal behavior in hypertensive men during a discussion with their wives. In Chapter 3, a replication of this experiment with one couple was reported. Apart from coding the interaction with the Marital Interaction Coding System (MICS; Weiss & Summer, 1983), we additionally measured speech duration, nonverbal behavior, and self-involvement of the hypertensive man. Self-involvement was measured with a frequency count of the words "I", "me", "my", and "mine". In contrast to the findings in the original report, BP reactivity did not covary with the amount of disruptive communication as measured with the MICS. Absolute BP levels of the hypertensive man did, however, correlate with his level of self-involvement, but only during discussions of hypothetical problems and not during discussions of their personal marital problems. This finding validates the notion that involvement covaries with BP, but also indicates that in hypertensives this relation may disappear during certain social interactions.

Scherwitz and his associates used a self-reference frequency count to measure self-involvement as a stable personality characteristic and found this measure to be prospectively related to coronary heart disease (Scherwitz et al., 1983). In a recent analysis of 750 interviews the predictive association between self-involvement and coronary heart disease was, however, not corroborated (Graham, Scherwitz, & Brand, 1989).

In an earlier report of this research group, the frequency count of self-references was used to measure change in involvement (Scherwitz, Berton, & Leventhal, 1978). Only later, the measure was used to assess self-involvement as a stable personality characteristic. Given the variability of this measure that we observed within a person, this measure is sensitive to change and not suitable to measure self-involvement as a stable personality characteristic.

Speech

The act of speaking is accompanied by large increases in BP in normotensives as well as in hypertensives (Lynch, Long, Thomas, Malinow, & Katcher, 1981). It is often argued that the BP response to speech is higher in hypertensives than in normotensives (Linden, 1987). There is, however, little evidence to support this assertion. We examined the BP response to speech in an experiment that is described in Chapter 5 and concluded that the magnitude of the BP response to speech does not differ between normotensives and hypertensives. There are, however, interesting differences in the pattern of the response between normotensives and hypertensives. In hypertensives the BP response to speech may be elicited quicker.

Interestingly, the magnitude of the BP response during a rest period in anticipation of tasks was larger in hypertensives than in normotensives. Whereas the BP response to anticipation of a task discriminates hypertensives from normotensives, the purely mechanical aspects of normal speech apparently do not. The only report of a higher increase in BP in hypertensives compared to the one in normotensives was found during actual interpersonal interaction (McKegney & Williams, 1967), which may point to an influence of interactional variables on BP during human interaction deserving further study.

Topic-involvement

In Chapter 6 the relation between topic-involvement and BP during a discussion was explored in normotensives and hypertensives. Self-report measures of general, positive, and negative topic-involvement were derived from affect scores of the Self-Confrontation Method (Hermans, 1987). Hypertensives and normotensives showed no differences in BP during short discussions on topics with little or much positive topic-involvement. A comparison of the BP of normotensives and hypertensives during discussions with extremes in negative topic-involvement revealed, however, a difference. More negative topic-involvement was associated with a rise in DBP in hypertensives but not in normotensives. This hyperreactivity in BP might point to difficulty with the expression of negative emotions in hypertensives.

That a higher positive topic-involvement is not necessarily accompanied by a higher BP level is supported by previous findings by others. The effect of a state of relaxation on BP and the effect of positive affect on BP was found to be similar, as were the self-report measures of affect during the two conditions (Yames, Yee, Harshfield, Blank, & Pickering, 1986). We can conclude that separate measures of negative and positive topic-involvement are apparently needed, as they covaried differently with BP in our experiment.

Hypertensives and persons at risk of developing hypertension appear to have a tendency to deny negative affect. This is illustrated by a study of the BP response of subgroups of normotensives with and without a family history of hypertension, demonstrating a relationship between personality characteristics and genetic predisposition (Jorgensen & Houston, 1986). Only the subgroup of subjects with a family history of hypertension that was characterized by denial and unwillingness to admit to neurotic feelings or aggressiveness exhibited exaggerated BP reactivity to experimental tasks. These findings raise questions about self-reports of negative affect and advocate the use of an instrument to measure the denial of affect (Little & Fisher, 1958).

Treatment

In Chapter 7, an interactional feedback program to alter the behavior of hypertensives during interactions is described. In a crossover design, the effect on BP of an experimental program and of a control program was assessed at home and at our laboratory. The control program consisted of biofeedback and relaxation exercises, the experimental program consisted of teaching hypertensives to alter interactional behaviors. The experimental program was found to be effective in lowering BP levels when subjects received this program first, followed by the control program. The effectiveness of a treatment based upon an extension of the experimental program in managing hypertension, certainly deserves attention.

The beneficial effect on BP was not observed in the subjects that received the experimental program after the control program. In contrast to the interactional program, the control program was characterized by little therapist-client interaction. Previous researchers have reported that treatment studies with a predominantly clinical focus have a larger effect on BP than treatment studies with a predominantly experimental focus (Lynch, Thomas, Paskewitz, Malinow, & Long, 1982). The assumption made was that a positive treatment expectancy and a favorable patient-practitioner relationship accounted for the difference in effect in the clinically oriented studies. In our study the treatment expectancy, initially induced by the first program, appeared to be a crucial variable in determining the effect of both programs.

In our laboratory, we used an advanced measuring device to give patients exact information on their BP level. Biofeedback training outside a laboratory will likely be unavailable through the absence of such devices. Therefore, teaching subjects to recognize observable dynamics of BP would be an attractive alternative. In an earlier experiment by Barr, Pennebaker and Watson (1988) the estimation by normotensive subjects of their BP level improved significantly when subjects were provided with individually assessed information on variables that covaried with BP. External variables, such as time pressure and evaluation by others, and internal variables, such as bodily sensations and moods, were measured during an assessment session. These findings suggest that biofeedback procedures can be made more efficient by teaching patients to pay attention to the individual-specific physical and environmental characteristics that are concomitant with high and low BP levels.

Self-monitoring of BP at home may be a valuable adjunct to treatment as it tends to decrease BP levels in most individuals (Laughlin, Fisher, & Sherrard, 1979; McGrady & Higgins, 1990; Woerner, Higgins, & McGrady, 1985). BP readings at home may furthermore prevent false diagnoses of hypertension. For many individuals, BP readings taken in the doctor's office may not give an adequate picture of BP at work or at home (Light, 1987). Such "white coat hypertension" is unrelated to anxiety and does not habituate or decrease with repeated office visits (Pickering et al. 1988). A "cuff response" or "disparity", as it is also called, was found to be predictive of success following a relaxation training (Godaert, 1986), a finding that is confirmed in our experiment because the hypertensives that showed the largest decline in BP during the program also had higher BP values at the laboratory than at home.

In general, relaxation and biofeedback are considered as a valuable adjunct to pharmacological treatment and not as an alternative (Seer, 1979; Wadden, Luborsky, Greer, & Crits-Cristoph, 1984). Only a few studies assessed the effectiveness of behavioral treatment programs in reducing BP levels in patients without antihypertensive medication (Julius & Cottier, 1983; Stainbrook, Hoffman, & Benson, 1983). A subgroup of patients may, however, adequately manage their hypertension with behavioral treatment programs alone. Recognition of the diversity of hypertensive patients has led to the search for profiles of patients who benefit most from behavioral treatment (Larkin, Knowlton, & D'Alessandri, 1990; McGrady & Higgins, 1989). Such studies, including hypertensive samples with and without pharmacological treatment, may lead to an efficient treatment strategy with behavioral, pharmacological, or combined treatments.

Behavioral treatment programs may furthermore result in larger BP decreases when they are not only directed upon the elicitation of the relaxation response. Upon acknowledging that stress is likely to be involved in BP elevation, it becomes clear that treatment should not only focus on relaxation but also on stressors (Johnston, 1985).

In normotensives a high speech rate causes larger BP increases than a low speech rate (Friedmann, Thomas, Kulick-Ciuffo, Lynch, & Suginohara, 1982). This effect was recently shown to interact with the effect of the topic discussed. Fast speech has a significantly larger effect on BP when one is engaged in an anger-arousing versus a neutral discussion and also influences the degree of experienced anger (Siegman, Anderson, & Berger, 1990). These findings underline the potential significance of voice modification as a therapeutic intervention.

Methodological considerations

Blood Pressure Reactivity

An important assumption for research on BP reactivity is that high BP reactivity plays a causal role in the etiology of EHT. Rosenman (1990) questions this assumption asserting that the evidence is still insufficient after a decade of research. Furthermore, animal studies indicate that basal BP levels and BP responses are to a large degree independently regulated (Reis & Ledoux, 1987) and suggest that hyperreactivity does not necessarily result in higher basal levels (Rosenman, 1990). The pathogenetic role of hyperreactivity clearly needs to be investigated in large-scale prospective designs evaluating the predictive power of reactivity measures. Measures should preferably be obtained from real-life events or from ambulatory monitoring (Light, 1987).

Baselines

In experiments on BP reactivity, the establishment of a proper baseline is crucial. Especially when studying hypertensives, attention should be given to the procedure that is followed to obtain a baseline. In the replication of the study designed by Ewart and his colleagues (1983), the experimental tasks consisted of discussions on personal and hypothetical problems. Baseline BP measures were obtained during conversations on topics "presumably unrelated to stress." While the interaction of the couple during experimental tasks was coded, a coding of the interaction during the baseline conversations was omitted from the experimental design. Our observations led us to the conclusion that the tasks during baseline were not sufficiently standardized. A coding of the interaction during baselines should have been included to allow a manipulation check.

A precise description of the activity that is required from a subject during a baseline is necessary, but not always sufficient. Depending on the setting, other variables deserve attention as well. Unaccounted for variables may also influence BP. Levenson and Gottman (1985), in studying married couples, noticed that even when no verbal interaction took place, considerable rises in BP occurred. They concluded that a reliable baseline could only be obtained in a separate session in which no interaction took place and where each spouse visited the laboratory separately.

The BP of hypertensives is clearly quite easily influenced by variables that might go unnoticed. Drummond (1985) found larger increases in SBP and HR in borderline hypertensives than in normotensives during the instructions that preceded a mental arithmetic task. Such initial influences may seriously affect further findings. Cumes-Rayner and Price (1988) showed that the common Law of Initial Values phrase "the higher the initial value the smaller the response" was related to an individual's reactivity rather than the chronic resting level to which we apply the labels normotensive and hypertensive. These experimenters emphasize that hypertensives often show a BP response to the initial contact with the researcher, which response influences later responsivity (Cumes-Rayner & Price, 1988, p. 188).

A solution to this problem can only be found in a precise baseline protocol of which the effects on BP are established. Studying such protocols, Linden and Frankish (1988) provided young normotensive subjects during baselines with three different tasks (a) resting quietly, (b) reading cartoons, or (c) reading stress-relevant questionnaires. Subjects were told to either expect or not expect to participate in a subsequent stress study. Instruction for activity was found to have no lasting effect after 20 minutes. HR adaptation occurred very early in adaptation protocols whereas BP adaptation was more gradual.

Light (1987) pointed out that variables affecting the baseline may be quite ambiguous and that the anticipation of an upcoming task and the perception of ongoing medical procedures can be threatening. These variables may affect some individuals more than others and are therefore matters of concern to researchers using measures of reactivity.

Concluding remarks

This study investigated the relationship between human interaction and BP. In our experiments we focused on variables such as speech, the topic of a conversation, and marital interaction. Furthermore, the effect of a program designed to change interactional behavior was evaluated. These experiments could only be designed after a new device became available enabling the continuous monitoring of BP for long periods of time.

In this series of experiments, we furthered the understanding of the role of individual variables that accompany increases in BP. We are now continuing this pursuit in current investigations by assessing the individual association of BP with both internal and external variables.

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Samenvatting

Bloeddruk in menselijke interactie

De experimenten in deze studie hebben tot doel variabelen te identificeren die bloeddrukveranderingen bepalen tijdens verbale interactie. Onze interesse gaat uit naar variabelen die samenhangen met bloeddrukstijgingen en specifieker naar variabelen die bij normotensieven op een andere manier samenhangen met de hoogte van de bloeddruk dan bij hypertensieven. Kennis van zulke variabelen kan van belang zijn om het ontstaan van essentiële hypertensie te begrijpen en is van nut bij het ontwerpen van psychologische behandelingsstrategieën voor essentiële hypertensie.

In de inleiding, Hoofdstuk 1, wordt uiteengezet dat experimenten die gedrag in relatie tot cardiovasculaire reactiviteit onderzoeken veelal gebaseerd worden op de veronderstelling dat het herhaald en gesommeerd voorkomen van verhoogde bloeddrukresponsen een rol speelt in de ontwikkeling van hypertensie. Verder wordt het concept betrokkenheid (involvement) geïntroduceerd. Betrokkenheid verwijst naar het verschijnsel dat een persoon werkelijk investeert in een interactie. Er zijn aanwijzingen dat de mate van betrokkenheid in belangrijke mate de hoogte van de bloeddruk tijdens een interactie bepaalt.

Hoofdstuk 2 bevat een literatuuroverzicht van studies waarin bloeddruk tijdens dyadische interactie onderzocht werd. De geselecteerde studies bevatten een voldoende gedetailleerde beschrijving en/of meting van tenminste één aspect van verbale interactie om een correlatie of oorzakelijk verband met corresponderende veranderingen in bloeddruk te kunnen ontdekken. Een classificatie van de studies naar onafhankelijke variabelen resulteert in vier categorieën. In de categorie *inhoud en emotie* treffen we studies aan waarin vooral de rol van kwaadheid en angst in de bepaling van de hoogte van de bloeddruk benadrukt wordt. Een tweede categorie, *interpersoonlijke variabelen*, bevat studies die de relationele elementen van een tweegesprek benadrukken. Het begrip dat hier centraal staat is betrokkenheid. Onderzoek dat gericht is op de invloed van de fysieke aspecten van spreken op de bloeddruk vormt de derde categorie *spraakgerelateerde variabelen*. Tenslotte wordt in een vierde categorie, *individuele verschillen*, ingegaan op de rol van relatief stabiele psychologische of biologische kenmerken zoals persoonlijkheid, erfelijkheid, en vooral het Type A/B gedragspatroon. Type A's blijken vooral tijdens een voor hen uitdagende interactie een grotere bloeddrukreactiviteit te vertonen dan Type B's.

Een beperking van het merendeel van deze studies lijkt de methode van bloeddrukmeten te zijn waarmee bloeddrukveranderingen gemeten konden worden met tussenpozen van 1 tot 60 minuten. Recent is er een instrument, genaamd Finapres, beschikbaar gekomen waarmee bloeddruk continu, noninvasief aan de vinger gemeten kan worden. Deze vinding kan een enorme vooruitgang betekenen in het bloeddrukonderzoek.

In Hoofdstuk 3 wordt verslag gedaan van de replicatie van een experiment waarin het communicatiepatroon van hypertensieven en hun partner door een training werd gevarieerd. In de oorspronkelijke studie bleek de reactiviteit van de bloeddruk van de hypertensieve partner te covariëren met kenmerken van de communicatie van het paar tijdens gesprekken over persoonlijke en imaginaire conflicten. In de beschreven replicatie bij een hypertensieve man en zijn vrouw werd naast de communicatie van het paar onder meer ook de betrokkenheid van de man gemeten. De bloeddruk werd in dit experiment niet-continu gemeten aan de arm. Er werd geen relatie tussen bloeddruk-reactiviteit en communicatiepatroon gevonden en er werden vraagtekens gezet bij de betrouwbaarheid van de gebruikte reactiviteitsmaat.

De bloeddruk van de hypertensieve man bleek wél te covariëren met zijn betrokkenheid, maar deze relatie bestond alleen tijdens discussies over imaginaire conflicten. Metingen van het negatieve verbale gedrag suggereerden dat de partners zich tijdens discussies over persoonlijke problemen terughoudend opstelden. Dit gold mogelijk in versterkte mate voor de man.

Hoofdstuk 4 geeft een beschrijving van het systeem dat in de volgende experimenten gebruikt werd. In dit systeem zijn de Finapres en een videorecorder aan een computer gekoppeld waardoor bloeddrukmetingen en opnamen van een interactie nauwkeurig gesynchroniseerd kunnen worden. Technische details en diverse toepassingen worden erin beschreven.

Het eerste experiment met deze opstelling wordt beschreven in Hoofdstuk 5. In dit experiment wordt de invloed van de fysieke aspecten van spraak op de bloeddruk onderzocht. Een overzicht van studies laat zien dat vaak gesuggereerd wordt dat hypertensieven een grotere bloeddrukrespons in reactie op spraak vertonen dan normotensieven, maar dat deze suggestie op weinig bewijs berust. In het experiment werd tijdens enkele eenvoudige taken — rust, stillezen, en hardop lezen — de bloeddruk gemeten bij normotensieven, hypertensieven, en met diverse antihypertensieve medicatie behandelde hypertensieven. Een verschil in de grootte van de bloeddrukrespons op de fysieke aspecten van spraak tussen normotensieven en hypertensieven kon niet worden aangetoond. Er werden wel aanwijzingen gevonden voor een snellere bloeddrukreactie bij hypertensieven dan bij normotensieven.

Verder werd een significant verschil in bloeddrukrespons gevonden tijdens de rustperiode voorafgaand aan de leestaken, maar niet daarna. Dit duidt op een sterke anticipatoire respons bij hypertensieven, waardoor een baselinebepaling waarschijnlijk alleen maar mogelijk is in een periode die na afloop van andere taken wordt ingelast en met name als zodanig wordt aangekondigd.

In Hoofdstuk 6 wordt nagegaan hoe de betrokkenheid op een persoonlijk gespreksonderwerp samenhangt met de bloeddruk tijdens een gesprek. De gesprekken werden gevoerd met een aangepaste versie van de Zelf-Konfrontatie-Methode. Hiermee werden ook zelfrapportages van gevoelsscores verkregen, waaruit maten voor algemene, positieve, en negatieve betrokkenheid werden afgeleid. Bij zowel normotensieven als hypertensieven werd geen verschil geconstateerd in bloeddruk tijdens de bespreking van onderwerpen met sterk wisselende algemene of positieve betrokkenheid. Wel werd een diastolische bloeddrukreactie bij hypertensieven geconstateerd tijdens onderwerpen met een relatief hogere negatieve betrokkenheid. Een onderscheid tussen negatieve en positieve betrokkenheid lijkt op grond van deze bevindingen gerechtvaardigd en wordt ook ondersteund door resultaten van andere studies die de invloed van afzonderlijke emoties op de bloeddruk onderzochten.

In Hoofdstuk 7 wordt ingegaan op de behandeling van essentiële hypertensie. Een vaak gebruikte effectieve gedragstherapeutische behandeling bestaat uit ontspanningsoefeningen, biofeedback, of een combinatie van beiden. Deze behandelingen kunnen mogelijk effectiever gemaakt worden door gebruik te maken van kennis van specifiek gedrag tijdens interacties dat met bloeddrukstijgingen gepaard gaat. Als een mogelijke voorloper van zo'n behandeling werd een procedure ontworpen waarin hypertensieven via deels individueel geïndiceerde technieken leren dit gedrag te veranderen. Het effect van deze procedure werd in een cross-over onderzoeksdesign vergeleken met een procedure bestaande uit biofeedback en relaxatie. Alle hypertensieven gebruikten bij aanvang van de procedures geen medicatie en registreerden zelf dagelijks thuis hun bloeddruk.

De volgorde waarin de twee procedures werden gegeven bleek bepalend voor het bloeddrukverlagend effect. Patiënten die eerst de interactiegerichte procedure kregen en daarna de biofeedback-relaxatie procedure, bleken zowel thuis als op ons laboratorium een duidelijke bloeddrukdaling te vertonen. De omgekeerde volgorde bewerkstelligde nauwelijks enig effect op de bloeddruk. Een verklaring voor dit verschil werd gezocht in een verschil in de mate van patiënt-trainer interactie tijdens de eerste procedure die patiënten kregen.

Hoofdstuk 8 bevat een algemene discussie waarin onder meer de op zelf-referenties gebaseerde meting voor betrokkenheid besproken wordt. Gezien de variatie die deze maat binnen één persoon vertoonde, werd geconcludeerd dat deze maat eerder veranderingen in betrokkenheid meet dan betrokkenheid als een stabiele persoonlijkheidstrek.

Ten aanzien van de invloed van de fysieke aspecten van spreken op de bloeddrukrespons wordt geconcludeerd dat deze bij hypertensieven niet lijkt af te wijken van die bij normotensieven. Een hogere bloeddrukrespons bij hypertensieven werd elders alléén gevonden tijdens interpersoonlijke interactie. Dit wijst erop dat vooral interpersoonlijke variabelen verdere aandacht verdienen.

Een belangrijke assumptie in veel bloeddrukonderzoek is dat een hoge bloeddrukreactiviteit een pathogenetische rol speelt bij essentiële hypertensie. Recent werd de geldigheid van deze assumptie in twijfel getrokken. Doorslaggevende argumenten zijn nodig en kunnen alleen verkregen worden uit grootschalig prospectief onderzoek waarin de predictieve waarde van reactiviteitsmaten wordt vastgesteld.

Verder wordt aandacht besteed aan het bepalen van een goede baseline. Bij hypertensieven levert een baselinebepaling gemakkelijk problemen op door anticipatoire bloeddrukresponsen en reacties op de interactie met de proefleider. Een goede baselinebepaling zal daarom bij voorkeur in een aparte sessie moeten plaats vinden of nadat de experimentele taken afgerond zijn en dit ook met name aan de proefpersonen is meegedeeld.

Bij het bespreken van behandelmethoden wordt een onderzoek aangehaald, waarin een individuele samenhang van bloeddruk met een reeks fysieke sensaties en stemmingen wordt gerapporteerd. Door deze bevinding kunnen biofeedbackprocedures mogelijk minder afhankelijk van apparatuur worden, waardoor hypertensieven buiten een laboratorium een belangrijk middel tot bloeddrukverlaging in handen krijgen. De opstelling die voor het onderzoek in dit proefschrift ontwikkeld werd, zal gebruikt worden om op deze laatste weg verder onderzoek te verrichten.

Curriculum vitae

Gérard Näring werd in 1951 geboren in Breda. In die stad behaalde hij in 1969 op het Onze-Lieve-Vrouwe Lyceum het eindexamen Gymnasium ß. Van 1969 tot 1973 studeerde hij wiskunde aan de Katholieke Universiteit Nijmegen. Daarna volgde, ook in Nijmegen, een studie psychologie. Als student-assistent gaf hij statistiek onderwijs aan studenten pedagogiek en werkte mee aan het samenstellen en corrigeren van tentamens statistiek voor studenten psychologie.

Tijdens het doctoraalprogramma klinische psychologie volgde na een dier-experimentele onderzoeksstage een klinische stage op de afdeling gedragstherapie van het Sint Jorisgasthuis in Delft. Via een volgend student-assistentschap kwam hij met het bloeddrukonderzoek van Martin van Schijndel in aanraking. De werkzaamheden bestonden uit het ontwikkelen van programmatuur voor bloeddrukexperimenten en data-analyse. Na het afstuderen in 1980 bleef deze samenwerking bestaan en volgden enkele publicaties. In deze periode werden zijn verrichtingen op gedragstherapeutisch vlak gesuperviseerd door Martin van Kalmthout.

Na enkele omzwervingen (o.a. ober in restaurant "de Steiger", automatiseerder bij de Sociale Dienst te Beek-Ubbergen) werd hij in 1984 methodoloog van het Medisch Research Bureau te Nijmegen. In 1985 keerde hij terug naar de vakgroep klinische psychologie en persoonlijkheidsleer in Nijmegen en startte als junior-medewerker met de studie waarvan in dit proefschrift verslag wordt gedaan. Daarnaast is hij sinds 1988 betrokken bij een onderzoek van Wim van Lankveld, waarin een vragenlijst ontwikkeld wordt voor het meten van stressoren en copingvormen bij reumatoïde arthritis.

Na de verdediging van dit proefschrift begint hij, weer in Nijmegen, aan het project "De individuele samenhang van bloeddruk met interne en externe variabelen."

This study focuses on the relation between blood pressure and human interaction. First a review of the literature is presented. In the four experiments that are described next, blood pressure of subjects with and without a diagnosis of essential hypertension is monitored during interaction. Among the aspects of communication that are measured are speech, involvement with content, and interaction style. Situations vary from a reading task to interaction with a spouse. Finally, a training program is presented and evaluated. The aim of this training program is to teach hypertensives to communicate in a way that prevents excessive rises in blood pressure.